INDIANAPOLIS MAY 5 1900 PUBLIC LIBRARY

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

VOLUME 23 — NEW YORK AND LONDON — NUMBER 18

Published at 218 William St., New York,
Every Thursday by the

American Machinist Press.
[INCORPORATED.]

JOHN A. HILL, President and Treasurer.
A. LEIGHTON DONNELL, Sec'y.

Also published at 34 Norfolk St., Strand, London, W. C.,
Every Saturday.

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Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist Press. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:
$3 per year in advance, postage paid, in North America.
$4 per year in foreign countries, postage prepaid.
No back numbers beyond current year.
For sale by newsdealers, generally.

AMERICAN MACHINIST CO., Ltd.,
34 Norfolk St., Strand, London, W. C.

FENWICK FRERES & CO.,
21 Rue Martel, Paris,
Representatives for France, Belgium, Switzerland and Italy.

V. LOWENER,
Copenhagen,
Representative for Denmark, Norway and Sweden.

GUSTAV DIECHMANN & SOHN,
Neue Promenade 4, Berlin,
Representatives for Germany, Austria and Holland.

Entered at New York P. O. as second-class mail matter.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

The Equipment of the Successful Inventor.

We have read with much satisfaction and profit the memoir of Hayward Augustus Harvey, inventor of the harveyizing process, recently issued by his sons. It is a worthy tribute to the memory of a man of admirable traits of character and of large mechanical achievement. The writer of the memoir suggests that Harvey was a striking example of the heredity of genius, because Gen. Thomas William Harvey, his father, was a prolific and successful inventor before him. The question of the inheritance of mental predisposition and predilection is always a more or less debatable one, and we cannot attempt to settle it in this case or in any other. If pronounced abilities are transmissible, why are there so many most evident failures? The evidence seems to be all against, rather than in favor of any transmission of exceptional mental traits. Gen. Harvey, it seems, had five children; yet we hear only of this one as following in the same line with the father.

What the memoir does bring out with the greatest sharpness and force, however, is the impulse of early association, the result of the constant exercise and training of the faculties in a given direction, the advantage of the most complete and advanced knowledge in any field for one who is to push achievement farther.

Gen. Harvey in 1815, then twenty years of age and already an able blacksmith, settled in Jamestown, N. Y., and soon was the builder of machinery for that section. At thirty-five years of age, or in 1830, he had perfected a line of machinery for making wood screws, and built up a flourishing screw industry at Pougkeepsie, N. Y. Here he also devised and perfected many other inventions, and later, in New York city, he became interested in the iron and steel business, and was spoken of as "a man of great experience in the manufacture of iron and well known as a practical mineralogist." Early in the forties he conducted an exhaustive series of experiments with electricity, and he had at that time a machine shop, the power for which was furnished by an electro-magnetic engine. The last few months of his life—he died in 1854—he devoted to the developing of a method of making steel from the ore by one process, and had he lived but a short time longer it is probable he would have accomplished his object. He was also interested in many other then developing industries, the making of pins, haircloth weaving, a flanged spike, a rotary toggle-joint press, which was an important invention, and many other things. The memoir before us says:

"In such a school and with such a schoolmaster did the subject of this memoir receive his training—a training from which he graduated with his eyes ever watchful for new phenomena and his mind ever open to new ideas. In mechanics the development had been in the direction of automatic machinery, in metallurgy toward a careful study and laborious experimentation with new methods. The effect of this training is evident to those of his friends who are familiar with the long series of experiments in the supercarburization of steel, which led up eventually to the armor-plate process."

Instead of going to college the son went into his father's factory, became an expert draftsman, and knew all his father's experiments and developments. He early began his inventions, receiving a silver medal of the American Institute for a hay cutter when twenty-three. At twenty-six he had a wire mill of his own. After the death of his father, Mr. Harvey devoted himself to developing some of the former's unfinished projects. He developed a great invention of his own in the rolled wood screw and the process and machinery for producing it. The machines for this work when first exhibited were the admiration of the mechanical world, and were described as among "the most simple, ingenious and effective pieces of mechanism ever seen."

In 1885-6 Mr. Harvey had an experimental shop in Brooklyn. Here, as the outgrowth of attempts to harden the surfaces of bolts and nuts made of low steel, he succeeded in making out of a cheap grade of Bessemer steel razor blades in all respects equal to the best. The Harvey Steel Company was organized for developing the new process and manufacturing under it. In 1889 Mr. Harvey treated a block of steel with a view to give it great power of resistance to blows and strains which might tend to pierce or break it. Mr. Harvey's experiments were brought to the attention of the Navy Department, and they furnished him a plate 6 inches thick, which he treated and which was subjected to official tests, as were numerous other specimens later.

This was the beginning of the Harveyizing process. The memoir, which we have been following, concludes with a brief account of the essential features of the Harvey process. Steel had been settled upon as probably the only proper material for armor plate, especially for its facility of hardening, but the hardening by chilling was believed to be impossible without cracking, which, of course, would destroy the value of the plate. Compound plates were tried, but these failed because of the tendency to separate at the joint. Mr. Harvey solved the problem by the conception and proof that the large mass of an armor plate, if made of homogeneous low steel, could be *deeply* impregnated with carbon upon the impact face only by prolonged subjection of such face to the action of carbon under pressure, at a heat in the furnace chamber high enough to melt cast iron, and that the result of the prolonged heat and the persistent pressure of the carbon on the surface would be to cause such a *gradually* diminishing percentage in the distribution of the carbon inwards as to obviate all tendency to

crack at any pronounced line of demarcation. It thus for the first time became possible to produce a hard surface on armor by adapting it to be rapidly cooled without danger of cracking or separation. The adherence of the hard face of a Harveyized plate to the soft body and back, and the efficient yielding or cushioning effect of the back in allowing the hard face to yield when struck is due to the gradually diminishing distribution of the carbon behind the hardened surface layer or chill. That this invention, like every other, is to be successively improved upon, if not entirely superseded, does not in the least detract from the merit of it at the time when it was made, and under the circumstances which attended it. Harvey may or may not have inherited the abnormal inventive faculty; but, if he did, what about his father, whom the memoir makes practically as great an inventor as the son? The lifelong training and impulse for both father and son is sufficiently in evidence, and this is the part that it is safest to insist upon.

Conversion Tables for Foreign Weights and Measures.

The Philadelphia Commercial Museum, whose sole purpose is the promotion of American export trade, has done an eminently practical thing and an important and valuable service in issuing, for gratuitous circulation among American manufacturers, a neat and handy pocketable pamphlet of 32 pages, 8½x4 inches, containing conversion tables for changing foreign weights, measures and moneys into American, and *vice versa*. The tables are very complete, and arranged for easy conversion in either direction, as required. The metric system is, of course, principally dealt with, but a long heterogeneous list of the measures of various countries is given also. In moneys nearly every country seems to need a special table. And such a table is given for English, for French and for German money, with a list of coin and currency values for various nations.

Various suggestions are given in the introductory portion of the pamphlet, among which is the following paragraph:

"Catalogues, prices, descriptions, etc., should be in the nomenclature of the country to which they are sent, or at least in a common nomenclature, which is understood alike by buyer and seller. Thus, if we quote to a French customer 60 yards of cloth at 10 cents a yard, it is unintelligible to him; but if we offer him 60 meters (65.617 yards) at 57 centimes (11 cents) per meter, he understands it without difficulty, and is enabled to compare it with prices, etc., which he has been paying in other places. Gallons, pounds, yards, etc., have about the same significance to the foreign merchant as the pood, catty, pund, caudra or fanega have to the American merchant."

Semi-annual Prizes of the National Cash Register Company.

On April 7 occurred the semi-annual distribution of prizes for inventions and suggestions to the employees of the National Cash Register Company, Dayton, Ohio. We have spoken before of the practice of this company, and of the happy relations existing all around, so that we need not here go into details. The values of the various prizes were as follows: $50, $40, $30, $25, $20, fifteen of $15, fifteen of $10, and fifteen of $5, making a total of $615. The winner of the first prize was a woman, as also were several of the others. The range and style of the suggestions rewarded indicate how the thoughts of the workers penetrate the details of construction. A few of them, not all intelligible to outsiders, are as follows: "Print the lettering on No. 79 principle flashes." "Use steel instead of brass for punching key caps." "Construct No. 35 tape-printer so that the revolution shaft can be removed without taking off the tape-printer." "Use an extension on the side of the right-hand No. 35 counter carrying lever to carry up the first counter wheel, and thus make it unnecessary to set the segment so wide, and also make the mechanism more positive." "Use simply a punched steel disk for the No. 79 check-paper roll guard." "Use a blank counter ratchet wheel instead of a finished trip cam on third wheel of No. 35 regular counter." The occasion was a notable one, as it marked the opening of a magnificent new factory building, which the growth of the business has demanded. A general entertainment occupied the entire evening, with music, drills, dancing and refreshments.

Date of Meeting of the British Institution of Mechanical Engineers.

Editor American Machinist:

In your issue No. 13, page 297, the meeting of the Institution of Mechanical Engineers is, by some error, stated to take place in the *second* week in June. Lest some of our intending guests from the kindred American societies be misled, would you kindly let your readers know that the annual summer meeting will be held in London in the *fourth* week in June—namely, June 27 to 29; when, in addition to a large gathering of our own members, we hope to be honored by the presence of as large a number of the American Mechanical Engineers as the steamers available are able to bring.

EDGAR WORTHINGTON,
Secretary, the Institution of Mechanical Engineers.
Westminster, England.

A Light High Speed Engine.

In the Boulte & Larbodière shops at Aubervilliers, a suburb of Paris, a remarkable steam engine is being tested, says the "Revue Technique." This engine is a double tandem compound one, lubricated under pressure. It yields 150 effective horse-power at an initial pressure of 100 pounds per square inch, and with the extraordinary speed of 900 revolutions per minute. The most rapid torpedo engines make only 600 or 650 revolutions per minute. In testing, it has been subjected to a pressure as high as 370 pounds per square inch.

This machine is constructed in part of aluminum. Its weight is less than 1320 pounds—that is less than 9 pounds per effective normal horse-power. It is thought that it may facilitate the solution of problems of motor carriage propulsion, aerial navigation, etc. We understand that these engines have already been adopted by several prominent French companies.

Technical Publication.

"The Tecnic of Mechanical Drafting." By C. W. Reinhardt. 36 8x11-inch pages, with 62 text figures and 10 full-page plates. The Engineering News Publishing Company, New York. Price $1.

This book, by the accomplished chief draftsman of the "Engineering News," relates exclusively to the mechanical execution of drawings. The author's work is, of course, chiefly the preparation of drawings for fac simile reproduction, for which neatness and uniformity of execution are essential. Those having work to do to which these qualities are important will find many useful hints in the book, though we should add that it relates chiefly to civil engineering, rather than machine drawings. Our readers are well aware that we do not approve of the use of conventional sections, of which the author gives a large number, though for his own use such sections add greatly to the pictorial effect.

A Familiar Experience for an Inventor.

"He had invented and built a machine for making nuts for bolts. It was a complicated piece of automatic machinery, and had taken many weeks to perfect. After his return from the town where it was building he was asked as to his success. He answered, 'I have had one of the great disappointments of my life. I did not see that machine in action but a moment, when there flashed into my mind the plan of a machine which would do the same work with about half the complications of the present one.'"—"Memoir of Hayward Augustus Harvey."

Inquiry for Machinery.

(123) The names of parties making machinery for automatically making small castings, such as gears, dials, etc., from aluminum or other alloys.

Commercial Review.

NEW YORK, SATURDAY EVENING,
April 28, 1900.

DYNAMOS AND MOTORS.

This is inclined to be a slack time of the year in the small motor trade, since manufacturers add less to their equipments in the spring than in the fall, and the effect of seasonable influences of that character is now discernible. The same seasonable characteristic may be predicated of lighting plants for which the heavy demand comes from August onward. However, the impetus of the boom of 1899, which knew no seasons, is still powerful. Electrical equipments, though getting to be almost a necessity for an enterprising plant, are not indispensable, as are some kinds of machinery. Now that the profits of two years of industrial prosperity are in hand, temptation to indulgence in luxuries is strong, and this is a factor making for the welfare of electrical apparatus constructors to-day.

A prospective electrical railway undertaking in this vicinity which will be of considerable interest and importance, though not equal to the equipment of the Manhattan Elevated, now in progress, will be the introduction of electric traction upon the Brooklyn Elevated. It is said that there will be a power house and motor equipments required, and that 20,000 horse-power will probably be involved.

Another British street railroad system must soon be added to the list of those undergoing equipment with American electrical machinery. A tramway in Birmingham, England, which is presumed to be of considerable magnitude, is to be equipped by Ross & Mackensie, of Montreal, Canada, who, it is said, have bought the road. The General Electric Company will build the electrical machinery for this outfit.

The Bullock Electric Manufacturing Company has received an order from the Montreal "Star" for a teaser outfit, including generators and motors, amounting to several hundred horse-power.

An event of interest in electrical finance is the appearance of the General Electric Company's annual report. The statement for the fiscal year ending January 31, 1900, has lately been given out in pamphlet form, with a lucidity and candor of detail not always found in the reports of large corporations. We have already published approximately the amount of orders received by the company for the last year. In exact figures it is $26,323,626, as compared with $17,431,327, $14,382,342, $11,170,319 and $13,235,016 for the four fiscal years previous. The total sales as billed to customers amounted to $22,379,463.75, which, deducting cost of goods sold, general expenses, taxes, depreciations, losses and allowance for losses, left a profit on sales of $3,805,860.18, or about 17 per cent. Other items in the profit and loss statement swell the total net profits to $5,479,130.20. The General Electric Company trade is characterized at present by a demand which bids fair to swell this year's total far beyond that of last. Prices are unchanged and deliveries about the same as they have been for generators and stationary motors, while the increased facilities of the company enable them to turn out traction motors on shorter notice than they were able to do some months ago.

The Crocker-Wheeler Company has removed its main office to the works at Ampere, N. Y. Mr. F. S. Blackall remains at 39 Cortlandt street, New York, as manager for the Metropolitan district, as well as senior partner of the firm, Blackall & Baldwin, the company's selling agents for this region. The firm has lately sold to Abraham & Straus, a large Brooklyn department store, a 200-kilowatt generator to go with a C. H. Brown engine; for the West Shore terminal at Weehawken, N. J., a 50-kilowatt machine, and a power plant for the Symphonium Manufacturing Company, which is moving from this city to Asbury Park, N. J.; besides other orders.

MISCELLANEOUS.

Never another substantial industry, perhaps, made its debut accompanied by so much wind, claptrap and fake business as the automobile trade. Almost daily the reports of new corporations show some concern chartered for the purpose of making, dealing in or operating horseless vehicles. Their authorized capital gives an aggregate somewhere in the hundreds of millions.

It is a profitable theme for curiosity how many of these new manufacturing concerns are merely paper corporations, organized to sell shares of stock to a trusting public or for equally laudable purposes. One would suppose that with so much capital stock provided for there would be three or four big automobile factories in every town of the country. As a matter of fact it is said that the important ones now in operation are not more than half a dozen, but this is probably an underestimate. Additional concerns, with good money behind them, are now getting in shape for work on an extensive scale. An electrical manufacturing company a short time since was supplying motors to as many as eighteen automobile makers. They included builders in a small way, such as carriage makers who are constructing from two to six horseless carriages apiece. The number of private parties such as these would, by the bye, have to be added to that of the chartered companies to allow for all that are in the business.

Much experimental work is being done in the automobile line, and some of it is undoubtedly destined to prove a success. Plans are laid in good faith which there has not yet been time to carry out. Still, when all allowances are made, the number of over-capitalized companies which are entering the automobile field is degrading to that trade, and is indicative of a very pernicious tendency now rife in American finance and industry.

The logical fate of these automobile adventurers is to be smashed to bits against the first rock they meet or to be ingulfed in some big concern. In our Manufacturers column this week we mention the formation of a company which, possibly, has the financial depth to become such an ingulfer.

Reasons are multiplying for the belief that the commercial future of this nation will depend very largely upon its ascendency in foreign markets, including those of the Far East. A summary of data showing the recent growth of American trade with this quarter of the world, lately sent out by the Bureau of Statistics, is truly astonishing. It calls attention to the fact that in the eight months ending February 28 our exports to Asia increased 38 per cent. and to Oceania 51 per cent., as compared with an equal period a year earlier. The most remarkable increase is in trade with Japan, to which country we shall have sent $26,000,000 of goods in the fiscal year (ending June 30) 1900, if business continues to the extent indicated by the first eight months.

In the fiscal year 1899 our exports to Japan were $17,264,688; in 1896, $7,689,685, and in 1893, only $3,195,494. Our export trade with that country has therefore multiplied itself by eight in the last seven years. For all Asia and Oceania the amounts for the same fiscal years are as follows: 1900, $104,000,000, estimated; 1899, $78,235,176; 1896, $42,827,258; 1893, $27,421,831.

In holding the Eastern market is it hardly to be supposed that manufacturers will always be able to obtain such prices as they have been accustomed to getting in prosperous times at home. Europe will be a sharper competitor when she has worked off her own boom now prevailing. To make many goods, to make them economically and to sell them cheaply should be the future American policy. The years between 1892 and 1898 taught some useful lessons. To see values recede from the high water mark of 1899 must be in some respects a cause for congratulation.

Mr. E. S. Redman, of C. Redman & Sons, Pioneer Iron Works, Halifax, England, machine tool makers, who has recently arrived in this country, proposes to place orders for some heavy slab milling machines and heavy turret machines for working on castings, to be used in the home establishment. Mr. Redman has not yet selected the machines. At the time of writing he is staying at the Hotel Albert, Eleventh street and University Place, New York. He will take a trip through the States before returning.

A traveling man for a local machine tool selling house is now on a tour through the Eastern and Southern parts of Pennsylvania, and reports a demand for tools

which the home firm regards as unprecedented in those regions.

The Goubert Manufacturing Company, makers of feed water heaters, etc., is fitting up for its use a new plant in Bayonne, N. J. The tool equipment, which is now being installed, comprises some heavy machines. It includes a 7-foot Betts boring mill, 54 and 56-inch Fifield lathes, 54-inch Gray planer, some Draper lathes, Prentice Bros. and McCabe radial drills. Pawling & Harnischfeger furnish a 5-ton traveling crane. The line shafting of the two bays of the building is connected by a rope drive.

The plant of the Atherton Machine Company, Lowell, Mass., is to be sold at auction May 17, under direction of the assignees. This is a concern of some magnitude, which has been engaged in the manufacture of cotton machinery. It comprises an extensive group of buildings and contains upwards of 200 metal working machine tools, besides a good deal of wood-working and other machinery.

A company has been started to aid the introduction of English and American agricultural machines and implements in Rhenish Prussia. Its intention is to open permanent exposition and sales rooms at Cologne, convenient to the agriculturists of the Rhenish and Westphalian provinces. The directorate is to be composed as follows: Two manufacturers, two important cultivators of the valley of the Rhine, the American vice-consul, the English consul and a lawyer. The capital subscribed is 200,000 marks (about $50,000), divided into 200 shares of 1,000 marks.

CINCINNATI REPORT.

The 25th has come and gone, and the threatened disruption of local machine tool and foundry working forces has not materialized. A conference with representatives of a half-dozen of the largest machine tool concerns in this section indicates that little apprehension is felt, and none at all of what may result from the policy of any strictly local labor organization. It is tacitly understood here that the situation is virtually controlled in the New York headquarters of the labor organization which is agitating the troubles. All local shops seem to be working full force, and the demand keeps up surprisingly well. One large machine tool making concern, whose executive head has just left for Europe, reports enough orders on the books to keep an average force busy all summer. There has been a general stiffening in domestic orders during the past ten days. A report received here from Cleveland says that machinists there have discovered that the manufacturers of Cincinnati and other cities are rendering their beleaguered brethren in the Forest City substantial aid to defeat the strikers, and that the strikers have evolved a plan to retaliate. Within the past few hours there have been heard rumors of a general strike throughout the entire country, and that it will be ordered in a short time.

One of the largest contracts taken by a Cincinnati concern of late is that secured by the International Steam Pump Company branch from London for material to equip the pumping station of the Coolgardie mines at West Australia. The region is on the edge of the great Victoria desert in West Australia, and there being no water in the country to facilitate the usual mining operations in which hydraulics cut such an important figure, the water has to be pumped and carried a distance of 300 miles. For this work engines and pumps of an immense capacity are required. This contract has been taken by the Cincinnati branch of the International Pump Company.

There has been considerable hesitation hereabouts in the wire trade, competition beginning to manifest itself. An Ohio concern, with connected rod mill, steel plant and blast furnaces, and the newly equipped Birmingham (Ala.) plant have, between them, s fficient capacity to be felt in a waiting market.

At the local jobbing houses the demand for drills and machinery of this caliber continues firm, with a marked preference for first-class goods.

At this writing the Cincinnati delegates to the National Association of Manufacturers' convention in Boston are just returning. Cincinnati this time sent two sleepers full of delegates, half of whom are executives of wood-working and machine tool making establishments.

CHICAGO MACHINERY MARKET.

There is a marked activity in the street railway electrical equipment market in the West. At a great many growing cities plans for a consolidation of existing plants are under way or have already resulted in the placing of orders. Three of the most notable are those of the Chicago City Railway, the combined Kansas City power and lighting companies and the street railway system of Milwaukee. Plans for the centralization of the power of the Chicago City Railway are almost completed by Pierce, Richardson & Neiler of this city. It is proposed to combine the two electrical power houses, and also probably the three cable power plants. Provision is to be made for 20,000 horse-power in this central plant, the units to be engines of from 2,500 to 4,000 horse-power, according to guarantees made by bidders. The same electrical engineers have prepared specifications for the Kansas City improvements. They have asked bids for the boilers, and will shortly invite proposals for the engines and electrical machinery also. Sargent & Lundy, of this city, have prepared plans for an addition of 5,000 to 6,000 horse-power to the Milwaukee street railway system, to which the attention of manufacturers will soon be called. The Siemens & Halske Electric Company has just taken the contract for two generators of 550 kilowatts capacity each for the Consolidated Street Railway Company of Bay City, Mich. This same electrical machinery manufacturer now has under construction at its plant near Chicago fourteen machines of over 1,000 horse-power each, eight of which are in excess of 2,500 horse-power each. It is working 1,200 men and operating the plant up to midnight every day. The Chicago Edison Company is making extensive additions to its plant on Harrison street. This plant began operations in 1892 with 1,500 horse-power, and when the improvements now undertaken are finished the capacity of the plant will have reached 10,000 horse-power.

Among manufacturing plants there is likewise a good active trade in electrical equipment. By a number of local sellers the observation is made that during the past few days inquiries have increased notably, even from the city district proper. Many of these inquiries will not develop into orders until the strike of the building trades is at an end. The Crocker-Wheeler Company has sold a 200-kilowatt direct-connected generator to the Thomas Emery estate of Cincinnati, Ohio, and a 225-kilowatt generator to the Page Woven Wire Fence Company, of Monessen, Pa.

Quotations.

NEW YORK, Monday, April 30, 1900.

Iron—American Pig, tidewater delivery:—

Pennsylvania Irons:

No. 1 X foundry	$22 00 @ $23 00
No. 2 X foundry	21 00 @ 22 00
No. 2 plain	19 00 @ 20 00

Alabama Irons:

No. 1 foundry	22 25 @ 22 75
No. 2 foundry	21 25 @ 21 75
No. 3 foundry	20 25 @ 20 75
No. 1 soft	22 25 @ 22 75
No. 2 soft	21 25 @ 21 75
Foundry forge	19 50 @ 20 00

Bar Iron—Base sizes—Refined, mill price on dock, 2 @ 2.10c., with good brands selling at 2.40 @ 2.50c. from store in moderate quantities.

Tool Steel—Base sizes—Standard quality, 7 @ 8c.; extra grades, 12 @ 14c.; special grades, 16c. and upward. Tool steel of quite ordinary character is reported to have sold in large quantity at reduced figures.

Machinery Steel—Base sizes—Ordinary brands from store, 2.65 @ 2.85c.

Cold Rolled Steel Shafting—Base sizes—From store, 4c.

Copper—In carloads—Lake Superior ingot, 17 @ 17¼c.; electrolytic, 16⅞ @ 17c.; casting, 16¾ @ 17c.

Pig Tin—In 5 and 10-ton lots, 29¼ @ 30¼c., f. o. b., New York.

Pig Lead—Wholesale lots, 4.70c., New York delivery; carloads, 4.72½ @ 4.77½c.

Spelter—Prime Western, 4.65 @ 4.70c., New York delivery.

Antimony—Cookson's, 10¾ @ 11c.; Hallett's, 9⅝c.

Lard Oil—Prime City, 62c. in barrel lots.

A Geometric Boring Tool.

From time to time machines and devices for boring other than round holes have appeared. We present in the accompanying half-tone and line engravings illustrations of a recent device for this purpose, which certainly has the merit of remarkable simplicity, and which, together with its work, we have had the pleasure of seeing. Of the mechanical practicability of the device our readers can judge from the accompanying illustrations. The work, we may say, is apparently true and accurate, the holes made having clean, sharp angles. A disinterested and competent personal friend has seen the appliance at work, and, without having made a test, he estimates that the speed of drilling is from one-half to two-thirds of that of a twist drill, making the same size of round hole, it being understood that the holes are cut from the solid. It will be noticed that the device is in the nature of an attachment to a common drill press, and that it may be used on any such press. The fixture shown, while of entirely workmanlike construction, was made for the purpose of demonstration and will not take in a large piece of work. This, however, can be easily remedied.

Fig. 1 shows the device, complete, in position on a drill press table, the end of the usual driving spindle being seen above. The piece to be drilled is a flat bar of iron strapped to the table, and the cutting tool is in position ready for work. Two uprights are bolted to the table and to ledges on the inside of the uprights circular plates with central holes through them and forming shelves are bolted. To these shelves are bolted two stationary cam plates, and inside the cam plates are revolving cams having central hexagonal holes, through which the drilling tool passes with a good sliding fit. Cams and cam plates for the two shelves are identical in every particular. Their form and arrangement are more clearly shown in the top view of Fig. 2—the cam and cam plate shown in place on the fixture being suitable for making hexagonal holes, while the separate cam and plate at the right are of the proper shape for making square holes, and we may say here that holes having the profiles of all regular polygons, from an equilateral triangle up, may be made, as well as a vast variety of other shapes, including many with in-curved sides. Referring again to Fig. 1, the tool will be seen to be made of a hexagonal bar of steel, the hexagon of the bar being accurately machined to fit the hole through the center of the cams. To produce the polygonal holes the extreme cutting point of the drill must occupy a defined point relative to the cam—that is, the tool must be of suitable size and must always be inserted in the cam with its point in one, and only one, position. So inserted, the movement of the tool under the combined turning due to the drill press spindle and the radial oscillation due to the turning of the cams within the cam plates, is such that the extreme cutting point of the tool traverses the figure for which the cams and plates are laid out. This radial oscillation of the tool must, of course, be provided for in the connection to the drill press spindle, and this is done by the well-known Oldham coupling, shown in position in Fig. 1, and in parts in Fig. 2.

The cutting tool was included in the group of parts photographed in Fig. 2, the tool being located at the lower left-hand corner of the engraving. This picture does not, however, bring out the shape of the tool, which, of course, is peculiar, and in Figs. 3 and 4 are two additional views of it. It may be compared, so far as the cutting edge is concerned, to a flat drill with one lip ground away and the other extended beyond the center. The cutting edge is, however, curved in the manner shown. The point which describes the desired figure is the one which is on a prolongation of one of the angles of the hexagonal shank. At first sight it might appear that the clearance angle at this point is unfavorable, but this is an error. The cutting is done entirely on the end, exactly as with a common drill. That is, the cutting is on the bottom of the hole and not on its sides, and the angle between the sides of the hole and the heel of the tool is of no consequence. When dull, the tool is ground on a grindstone exactly as a flat or twist drill would be, except that the cutting lip is rounded instead of being straight.

Scattered about the lower part of Fig. 2 are various sample pieces with holes of various shapes made by the device, and of regular polygons the square, hexagon and octagon will be recognized. In addition to these are two other figures having in-curved sides, as already mentioned.

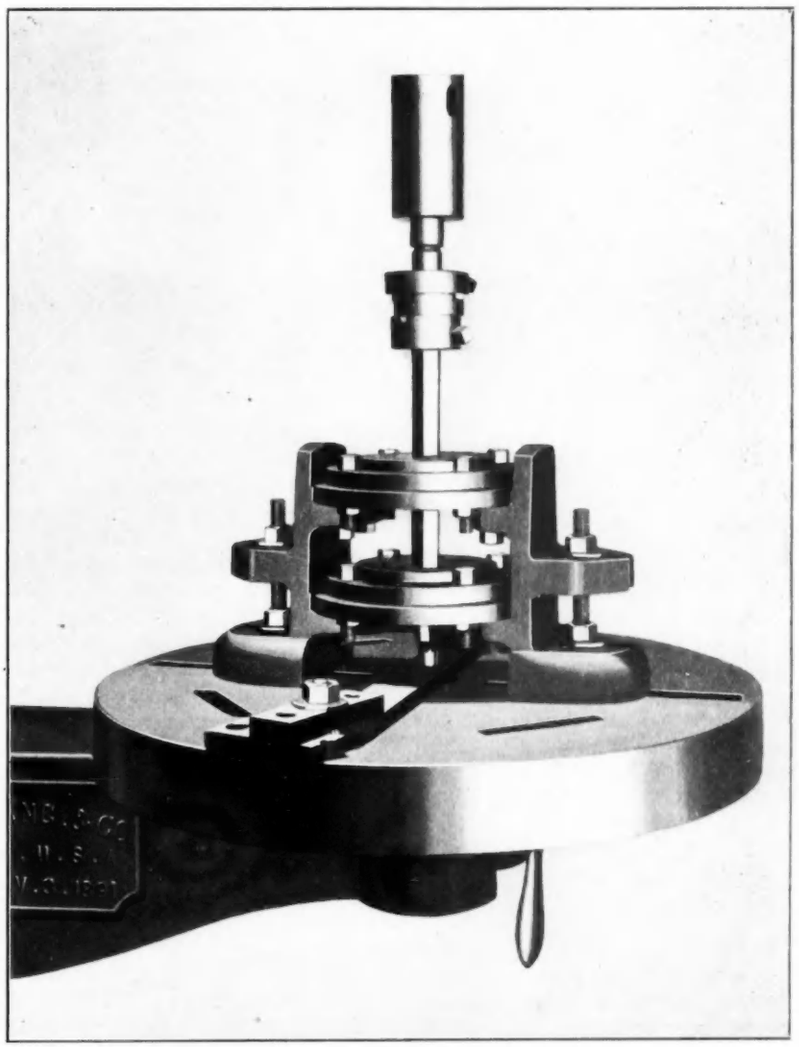


FIG. 1. DEVICE FOR DRILLING POLYGONAL HOLES IN POSITION ON DRILL PRESS TABLE.

Of course the central point of interest in the device is the cams and the method of laying them out. It is difficult to say whether these cams are an invention or a discovery, but whichever they are they are equally meritorious and remarkable. The conditions are that the inside cam must revolve freely within the outside one, but without lateral play in any position, and that some point of it, determined upon at

the start, shall describe the desired figure. Another desirable feature which is successfully embodied, is that the outline of the cam should consist of circular arcs only. We believe these cams have not been successfully analyzed mathematically.

cam, or with the tools in cams not intended for them, and it is by such combinations as these that the curious incurved shapes of Fig. 2 were produced.

Fig. 5 shows the method of laying out a pair of cams for drilling a square hole.

and *s t*, and inside the smaller square construct the equilateral triangle *n u v*. Now from points *n u v*, and with a common radius describe circles *A B C* tangent to three sides of the outer square. The arc 1 2 of circle *A*, between its intersections

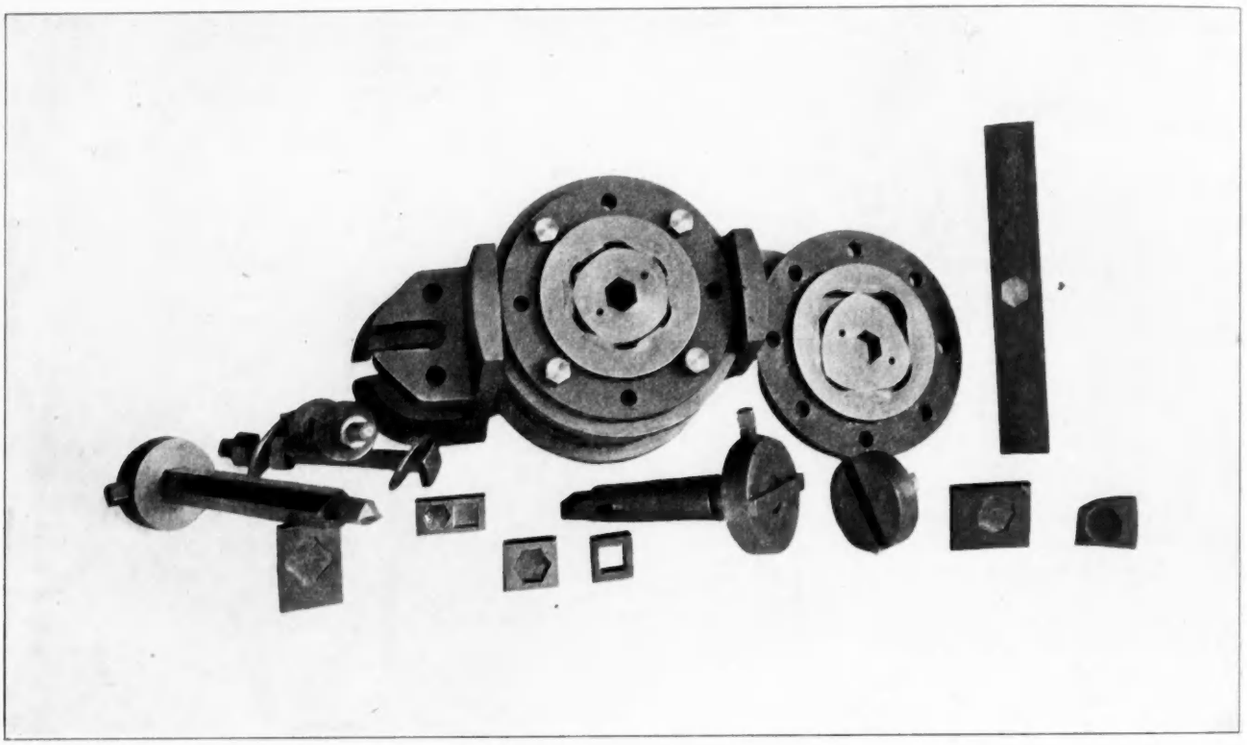


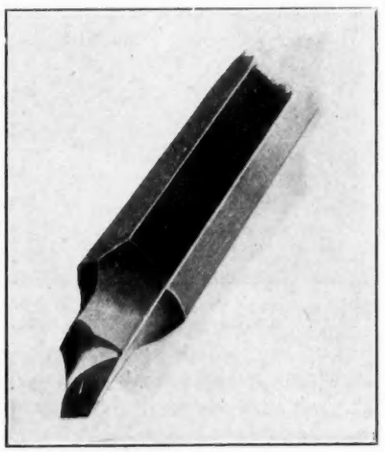
FIG. 2. DEVICE FOR DRILLING POLYGONAL HOLES DISASSEMBLED, WITH EXAMPLES OF ITS WORK.

At any rate it is remarkable that their inventor or discoverer makes no pretensions to mathematical knowledge. What the mental process by which they were developed, was, he only knows, and the probability is that he could not describe it to anyone else if he were to try. We give below the method of laying out the cams for square and hexagonal holes. There will be seen to be a similarity between them, and in fact the method of laying out may be stated in general terms, or directions, from which cams for boring any regular polygon may be laid out.

The outer or stationary cam is a simple polygon similar to, but larger than, the one to be made by the device, except that it need not be complete up to the angles, and is not in the cases shown in Fig. 2. Hardened plates will be seen to be inserted in the sides to cover the acting parts of the sides of the complete polygons. Any convenient size may be used for this outer cam, and, once made, it is suitable for all sizes of figures of its own shape, except those that are too large to come within its range. The inner or revolving cam is suitable for one shape and size of hole only—each size of hole to be made requiring a drill or tool of its own, as with round holes, and in addition a pair of the revolving cams. The device is, however, operative with the tools misplaced in the

Draw the vertical and horizontal center lines *a b* and *c d*, and about the center *e* construct the square *f g h i* to represent the hole to be drilled, and, concentric with it and of any convenient size, construct

with lines *q r* and *s t*, is a portion of the required profile of the revolving cam. From point *n* describe also arc *D*, tangent to the lower side of the outer square. The length of this arc between points 3 4 where



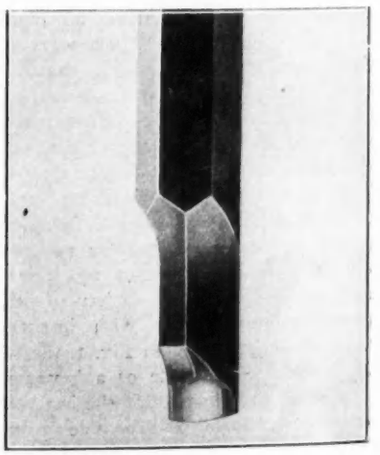


FIG. 3. FIG. 4.

TOOL USED IN DRILLING POLYGONAL HOLES.

the outer square *j k l m*, which represents the stationary cam plate. Point *n* of the intersection of *c d* with the side of the square indicates the point to which the extreme edge of the tool must be set. Through points *n* and *o p* draw lines *q r*

it intersects the lines *q r* and *s t* forms another portion of the required cam curve. From points 3 and 4 respectively, with radii 3 2 and 4 1, describe arcs *E F* intersecting the sides of the outer square at points 5 6. The arcs 1 6 and 2 5 constitute

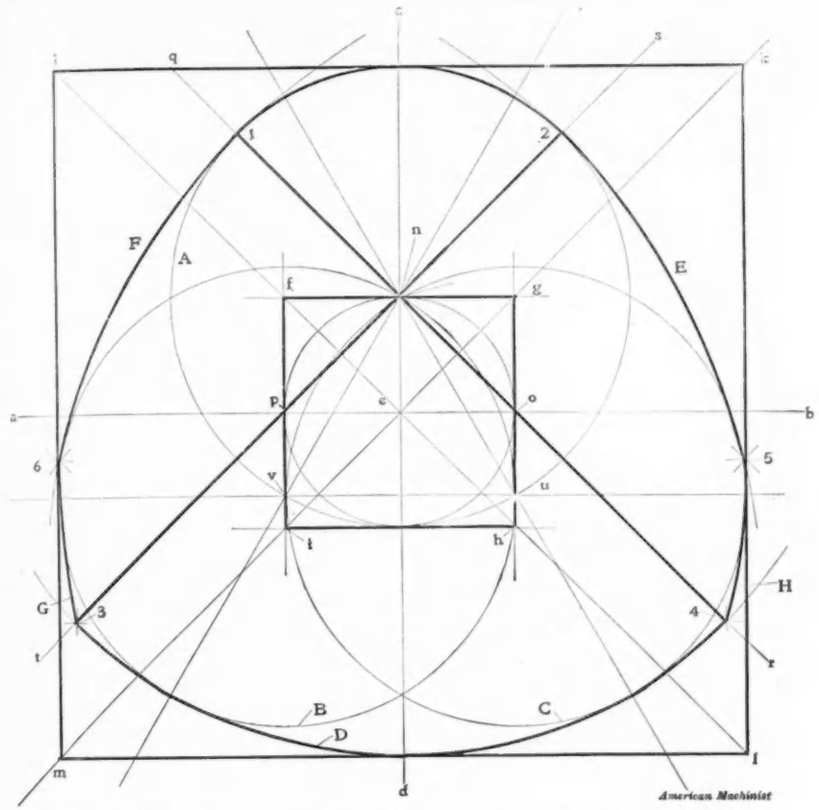


FIG. 5. METHOD OF LAYING OUT CAMS FOR DRILLING SQUARE HOLES.

actual construction would be very simple. With a master cam of each size once established, future duplicates would be very readily produced on a cam-cutting machine, and in fact it would be a simple matter to arrange a machine for grinding them and so supply them of steel, hardened and ground. It is perhaps unnecessary to add that the arrangement can be inverted and used in a lathe for turning as well as boring.

Of course the natural criticism of such a tool is that not many polygonal holes or shafts are needed, but with a cheaper way to produce such forms than we now have, it is quite probable they would be used much more extensively than they now are. However, such a tool has, probably, more applications already than anyone would expect. It would seem to be an ideal device for a bolt and nut works—for example, in making bolt head and nut dies. Those who have ever had a socket wrench to make would appreciate it, and there are many places where the ability to countersink hexagonal recesses for bolt heads would be highly useful. That it is a practicable method of doing its work there does not seem to be room for doubt.

The tool is the invention of Mr. A. K. Phillips, Roe Building, St. Louis, Mo.

"The college is to develop the man by a liberal education; the university is to make him a specialist."—Seth Low.

"The college turns the iron into steel; the university turns the steel into tools."—President Schurman of Cornell.

additional portions of the required profile. Finally from points 5 and 6 describe arcs *G H* between points 3 6 and 4 5, and the cam is complete.

Fig. 6 shows the construction for a cam for drilling hexagonal holes. The hexagons to represent the hole to be drilled and the stationary cam will be recognized. As before, point *n* indicates the position of the extreme point of the cutting tool. Draw the equilateral triangle *n u v* within the inner hexagon and prolong two of its sides in the lines *a b* and *c d*. From points *n u v*, and with common radius, describe as before circles *A B C* tangent to three sides of the outer hexagon. Arc 1 2 of the circle *A*, between its intersections with *a b* and *c d*, is a portion of the required profile. From point *n* describe also arc *D* tangent to the lower side of the outer hexagon. The length of this arc between points 3 4 where it intersects the lines *a b* and *c d* forms another portion of the required cam profile. From points 3 4 describe, with radii 3 2 and 4 1, arcs *E F*, intersecting the perpendiculars *e f*, *g h*, to the sides of the hexagons at points 5 6. Arcs 1 5 and 2 6 form additional portions of the required profile. From points 5 6 as centers, and tangent to the opposite sides of the hexagon, describe arcs *G H* forming additional portions of the profile. Finally, from the angles *i j* of the inner hexagon describe arcs *I J*, and the figure is complete.

It may be worth while to mention that the holes through the cams shown in Fig. 2 are not necessarily of the profile to be made by the cams, and in fact the cam for making the square hole has a hexagonal hole through itself.

While the process of laying out the cams is somewhat elaborate, it is clear that their

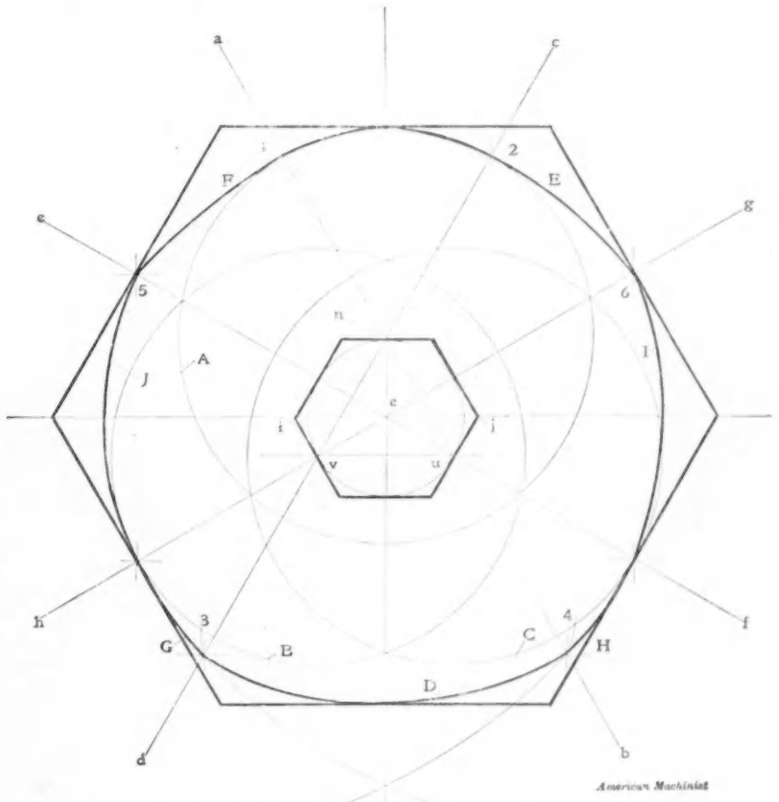


FIG. 6. METHOD OF LAYING OUT CAMS FOR DRILLING HEXAGONAL HOLES.

Shops of Wells Brothers, Greenfield, Mass.

The half-tones give us some interesting views of a comparatively new factory in an old New England town. It is the establishment of Wells Brothers, the well-known manufacturers of taps and dies and screw-cutting appliances, at Greenfield, Mass. The buildings prove very satisfactory for the purposes for which they were designed and built, giving light and comfort and every facility for the handling of the materials and convenient manipulation of the work, and they are withal not of costly construction.

Fig. 1 gives a general exterior view of the buildings. The main building in the foreground is 200x100 feet, with some smaller buildings on the farther side of it, where are the power house and its appurtenances, storage for materials, etc. The building at the left is about 100 feet square, the total floor area, including the small buildings, being about 40,000 square feet. The buildings embody the Edward Atkinson slow-burning type of construction, heavy timbers supporting the roof throughout, there being no air spaces anywhere, and all the floors being of cement. Besides the practically continuous windows all around the buildings, the large skylights, extending nearly across, light

FIG. 1. SHOPS OF WELLS BROS., GREENFIELD, MASS.

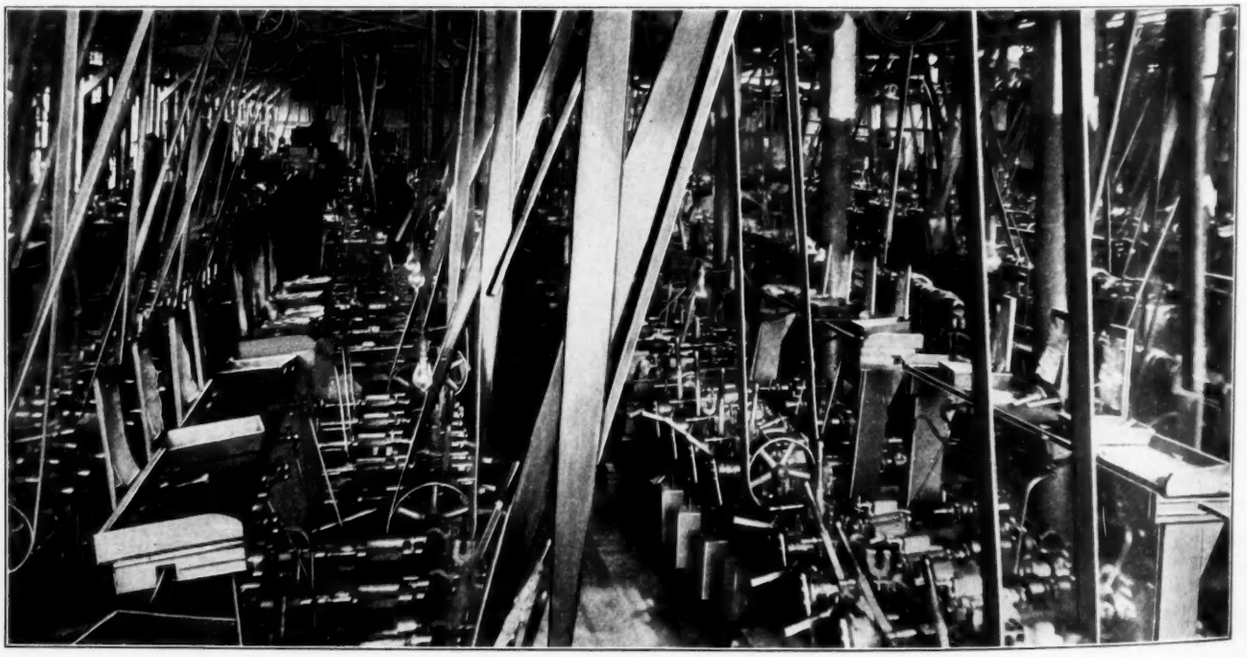


FIG. 2. AUTOMATIC THREADING MACHINES.

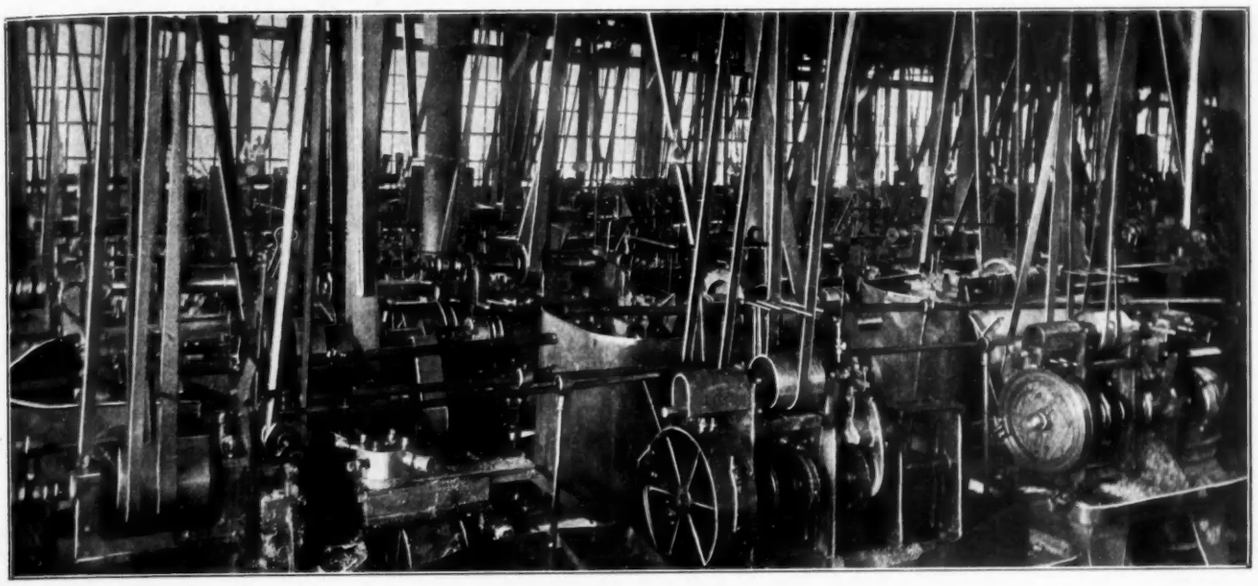


FIG. 3. SCREW MACHINES AND OTHER AUTOMATIC TOOLS.

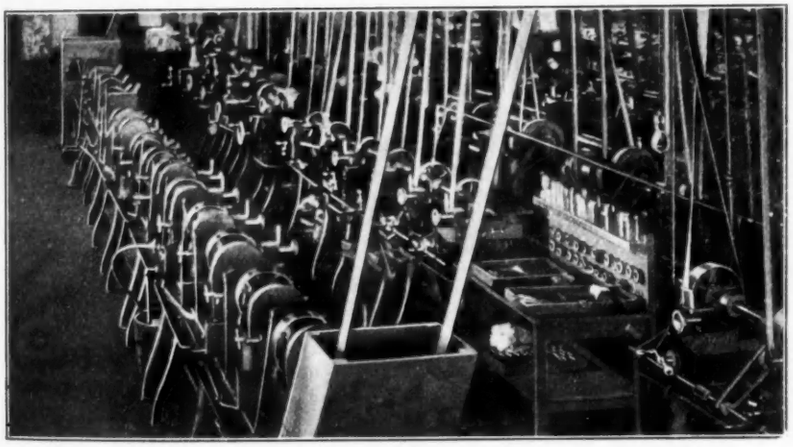


FIG. 4. AUTOMATIC SQUARING MACHINES.

the interior very satisfactorily. The shops are of ample hight within, notwithstanding the suggestion to the contrary from the outside view. The offices, which are large and handsome, are in the near corner of the first building, the storage for finished stock being to the left of the office and on the other side of a long passage, extending from the double doors back into the shop.

The machinery used throughout the factory is for the most part completely automatic, and as much of it has been designed and constructed for the special line of work done here they are not making any special effort to publish the details. Fig. 2 shows the threading department, where the threads of the taps are very cheaply and correctly cut or milled by some of these home-made automatic machines. Fig. 3 shows automatic machines of various types, turret lathes, screw machines and others, making a large variety of parts, such as screws and taper pins, and also turning the tap blanks before threading. In Fig. 4 are seen machines for squaring the ends of the taps. The mode of driving will here be noticed. A single belt drives a long row of machines. The frame or standard of each machine carries its own piece of line shaft near the floor, and when the machines are all in place these several pieces are loosely connected by knuckle joints, no care being required as to accurate alignment. Each machine may be stopped or started by its own clutch independently of all the rest. Machines also may be taken out of the line when necessary without interference, a blank piece being coupled into the shaft to fill the gap.

Fig. 5 shows the mode of carrying the numerous countershafts throughout the establishment. The line shafts have Hyatt roller bearings in all the hangers and wood split pulleys. For the countershafts strips of plank, with both edges planed V shape,

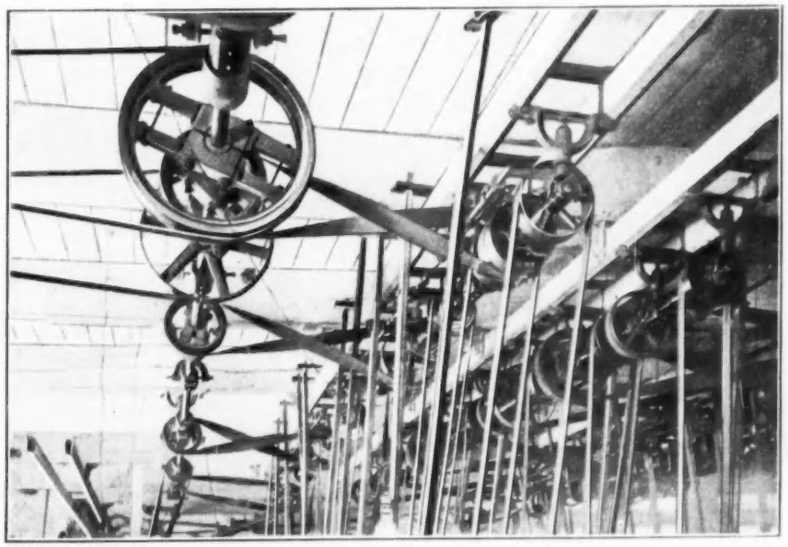


FIG. 5. SHOWING HOW COUNTERSHAFTS ARE CARRIED.

are set edgewise and secured by angle irons to the overhead timbers, leaving both edges and one side of each free. The hangers have V notches which fit the edges of the planks, as have also the binders which go on the top of the planks. The countershaft hangers can thus be slid along wherever desired, and when they are tightened in position each helps to bind the system firmer.

The Economics of the Premium Plan.*

BY F. A. HALSEY.

What I wish chiefly to speak of to-night is the premium plan from an economic standpoint, my object being to show that the common impression that the premiums are an additional charge or tax upon production is unfounded, and that, in point of fact, the very opposite is true. It is in consequence of this mistaken opinion that many look upon the system as a transition or makeshift system, to be used as a temporary spur, but to be eventually gotten rid of. I am here to combat this opinion and, more than this, to show that, in point of fact, the dollar paid in premiums is the best and most productive dollar spent anywhere about a machine shop, and, as such, is the last one which the employer should endeavor to "save" by cutting the premiums or by limiting them in amount. In all that is said in what follows against cutting the premiums, that phrase is to be understood as meaning *cutting because the workman earns too much.* When new methods of production are introduced, a readjustment of premiums is necessary as a matter of course, and nothing in what follows is to be understood as condemning such readjustment.

It ought not to be necessary to urge that when a workman by earning an extra cent for himself earns at the same time one or more cents for his employer, the employer should bid him God-speed in earning all he can, and should recognize that to set a limit to what the workman shall earn for himself is simply to limit what he shall earn for the employer, or, in other words, to kill the goose that lays the golden egg. Nevertheless, the shop atmosphere of this country is simply saturated with the idea that the employee shall not be permitted to earn beyond a certain limit. This, no doubt, is largely due to the baleful influence of the piece-work system; but its existence is the chief obstacle to the progress of the premium plan. So long as there is a fair and equitable division between the employer and employee, why should there be any limit set to what the latter can earn, except that set by what he can do? There is but one answer—there should be no such limit.

We all believe, and are glad to believe, that skilled labor receives higher wages in this country than in any other, but if the growth of our export trade during the past three or four years has taught us anything, it is that such wages are not a tax upon production. Political economists of the old school tell us that the American workingman receives more than others because he does more, and that the increased wages received are but his share of the additional wealth produced. The protectionist school of economists simply reverse the order of cause and effect and declare that the increased wages are due to protection, the increased production resulting from the better food and greater interest in life which the higher wages give. I am not here to argue the truth or falsity of either contention, but to point out that they agree in the conclusion that the increased wages and increased production go together, and that the one justifies the other. This is, after all, but a declaration that efficient labor is worth more than inefficient labor. This is very nearly a truism, but all the better for that. If it were necessary to enter upon a labored argument to establish a basis for the premium system, you might be excused for feeling that a truth which required so much proving might not be a truth after all; but, reduced to this bald statement, there is no room for doubt. If it be a fact that efficient labor is worth more than inefficient labor, then the premium plan is founded upon a rock. The case in a nutshell is, that this system contemplates a permanent increase in the efficiency of labor, and with such increase of efficiency a permanent increase of wages is economically justified, and just as with the American workingman in general, such an increase is simply the workman's share of the increased wealth produced. In place of general conditions which are so vague and uncertain in character as to defy positive indentification, but which by common consent have produced tangible results, this system introduces the most powerful incentive to exertion known to man. For the sake of money men go to the ends of the earth and undergo hardships to the limit of endurance. He who doubts the potency of money to increase output in a machine shop, has not learned the first elements of human nature, and not only has he not learned these first elements, but his opinions on this subject are of no value, for it must be remembered that the world as a whole does not know, and very few individuals in it know, what a machine shop can be made to produce under a system in which earnings increase so long as production increases. The experience of the world is based on systems which offer no incentive (day work) or those in which the incentive is soon destroyed by rate cutting (piece work). In view of this, opinions regarding the value of incentives, offered by those who have made no trial of them, are valueless.

It needs no argument to show that the resulting benefits are far reaching. A high rate of wages *based on a high rate of production,* is the keynote of general prosperity, and by increasing the workman's ability to consume all other goods, it "puts money in circulation" in a way which is economically sound.

Not only are the premiums *not* a tax upon production, but it is as easy as possible to show that they are the direct opposite—that the return for the money paid as premiums is greater than for any other equal amount paid out. To make the matter perfectly clear, consider a concrete, though extreme, case. Suppose a workman running a large boring mill costing, say, $15,000, his wages being, say, $3 per day. If interest and depreciation, taken together, be charged at the moderate rate of 10 per cent., a charge of $1,500 per annum, or approximately $5 per day, must be met. If the further charge for providing for this tool a house, superintendent, foreman, draftsman, power and supplies be made, together with a suitable allowance for the time which the tool stands idle, or does work within its proper capacity, we shall find a total charge for each running day of more nearly $7 than $5, and the workman's wages begin already to look insignificant in comparison. Suppose the workman is offered a premium of 15 cents per hour for each hour saved, and note the results. For the sake of easy calculation, suppose the workman to double his output, or do a job in one day which has previously required two. The original cost of the work was the entire cost of operating the machine, that is, expenses $7, plus wages, $3, or, say, $10 a day for two days, or $20 total. The new cost of the work is the operating cost of one day, or $10 plus the $1.50 paid as premium. That is to say, the payment of $1.50 to the workman has saved $8.50 to the works. Looked at in this way, one becomes almost ashamed to give him so little for doing so much. Is it not absolutely clear that the dollar paid the workman as a premium is the most profitable dollar spent anywhere about the work, and is it not as clear that any reasonable inducement which can bring about such a result is economically sound, and may be assumed as a permanent feature without any risk whatever? Your answer will properly be that the case is hypothetical, that the ratio of expense to wages is excessive on the one hand, and that no such an increase as 100 per cent. is to be expected. In this you are right, of course; but the study of an extreme, though impossible, case points out all the principles involved, and shows most markedly that the premiums are the very opposite of an additional tax on production.

The study of the expense ratio is of prime importance in this connection, and

*Abstract of a lecture before the Providence Society of Mechanical Engineers. A new table of results actually obtained by the system was given, this table showing the effects on cost, output and wages, but its publication here is deferred, in order to give it in a later issue with similar figures which have been promised from other sources.

I am fortunate in being able to give some authentic figures relating to it. Some of you are no doubt acquainted with Mr. J. N. Gunn and his work. For the benefit of others I may say that this work is the reorganization of administrative methods in factories. An establishment which, by the growth of its business, has outgrown its old methods, but which is not sufficiently acquainted with advanced practice to introduce new ones, calls in Mr. Gunn for that purpose. In the pursuit of this work he has probably acquired a larger knowledge of factory finance, including actual expense ratios, than any other living man, and while his knowledge of individual cases is, of course, confidential, he has furnished for use this evening the following general statement:

"The figures that I give you and the statements that I make are taken from twelve representative concerns. I define as factory expense all expenses under the 'superintendent's hat,' except material and productive or direct labor; that is, labor chargeable to some specific article and that it is possible to locate upon one article as compared with another. The other expenses of the business, cost of conducting the business and selling expenses, vary so much that I take it you do not care to bring them into this discussion, as they do not vary according to the same laws that govern factory expense. There is not among these twelve plants one which has a lower ratio of factory expense as compared with this direct labor than 78 per cent., and this was only the ratio when the plant was running night and day on very large machine work. When the plant went back to its normal time of ten hours a day the ratio rose to 98 per cent. I found variations in this ratio of factory expense to direct labor, varying on the plant as a whole from 78 per cent. to 180 per cent. I found in one plant, where the ratio for the plant as a whole was 125 per cent., variations in the expense rate when analyzed by particular departments of from 57 per cent. to 280 per cent. A careful analysis and comparison of factory expenses in all of these plants, and in many others, leads me to believe that it is the exception to find a machine building plant in which the factory expenses are less than 100 per cent. of the direct labor."

There is but one lesson to be drawn from such an exhibit, and that is the same as, though less pronounced than, the one drawn from the boring-mill illustration, namely, the enormous importance of a large output to furnish a large denominator wherewith to divide the total expense and so reduce this ratio. The lesson of it all is that the large output is the cheap output and that the successful manager and the valuable workman are they who produce such an output. The problem of the day in machine shop management is, in fact, the production of such an output.

It must also be remembered that whatever increase of output there may be is accompanied by a corresponding reduction in next year's enlargement of plant, and, indeed, there are those using this system who assert that the gain from this source is so great as to make the rate of premium paid a matter of comparative indifference. With the cost of the work in hand reduced, the output which customers are crying for increased, and the necessity for constant enlargements of plant curtailed, it would seem as though one must be hypercritical to find fault with the plan, and yet—well, a prairie fire spreads faster.

It is natural to look with suspicion upon large promises, and perhaps if the system promised less it would spread faster; but it must be remembered that unless the system does all these things—reduce cost, increase output, curtail future enlargements of plant, and incidentally increase wages—it simply does nothing. If it does not accomplish these results it costs no one a single cent. Its results must be either positive or zero—they cannot by any possibility be negative.

The point which all the above is intended to enforce is, that the premium plan is not a temporary makeshift or transition plan, and that no one need ask "How long can we expect to allow matters to run before cutting the premiums?" or "How much ought we to allow the workmen to earn before making a cut?" With the showing made above, that the dollar paid in premiums is the most profitable dollar spent in the work, it would seem that the wise employer would be content to continue to spend them, and, whether content or not, it is my judgment that he must so continue, if good results are to be permanent. In fact, if there is anyone in this audience who contemplates trying the system, but who expects to cut the rates as soon as opportunity offers, he will oblige me if he will let the plan entirely alone.

An excuse may be offered for this tendency to cut the rates, that it is due to the habit of mind engendered by the piecework system. Under that system rate cutting is a necessity, and one who has not fully grasped the difference between the two systems may be excused for contemplating these cuts in the premium rates, but that does not change the fact that that idea must be entirely gotten rid of if the possibilities of the premium plan are to be realized. If rate cutting is necessary under this system then the system is a failure.

Any thorough study of the expense ratio will show that liberal premiums are justified by the results, but human nature is weak—especially human nature as manifested in a board of directors who know nothing of shop management or conditions—and hence I have always advocated moderate premiums, though fortunately the workman's interests are automatically safeguarded against niggardliness in this respect. If trifling premiums only are offered, the workmen will soon find that the premiums earned are not worth the effort necessary to earn them, and the employer will find his attempted close dealing will defeat itself. In this respect, like all others, the system is on a sound economic basis, and the principles to be followed in applying it resolve themselves at last into the same as those followed in any other. If we have a fence to paint, we offer enough to induce someone to do it. If we offer less than this the fence will not be painted, and if we offer more we pay more than is necessary. So here, the strictly economic principle is to offer enough as premiums to induce the workman to try to earn them. If we offer less he will not make the attempt; while if we offer more we will pay more than is necessary—though always less than we have been paying. The only difference introduced by the premium plan lies in the fact that in other lines of work the experience of the world shows quite clearly how much must be offered, while the body of experience with premiums is small. Of course, the exact line is obscure, and errors will be made in attempting to find it, but that does not alter the principle involved. With the premiums on this basis, it is clear that not only will production be cheaper than before, but it will be cheaper than by any other system whatever, since if less is offered the increased production will not follow, while if more be offered an unnecessary amount will be paid. The employer should ask himself how much it is worth to permanently increase his product. If he is willing to permanently pay a dollar a day to double the output of a given machine, then let him offer a premium of 10 cents an hour, and if for some smaller machine he can afford to pay but 50 cents a day for doubling the output, then let him offer a premium of 5 cents an hour, and let him remember that *unless he obtains the increase he will not have the premiums to pay,* and that if he offers too little he will obtain no results. Far more mistakes have, however, been made in setting too high a rate than the opposite. This system does not raise a man's wages in hopes that he will do more; it raises them *if* he does more.

I have nourished a hope that this system might furnish a bridge across the gap between employers and employees. This hope has been considerably dashed, but at the same time it is not in my heart to condemn the workmen for their action. When I contemplate the failure of so many employers to understand the system, I cannot criticise the workmen for failing to see at once its full significance.

The great object of the unions, as I understand it, is to increase wages. If they do not do that, or at least offer a promise of doing it, they have little excuse for existence, and but for such promise I do not think they could hold together long. At present, times are prosperous, manufacturers are making money, and increases in wages are the order of the day, but this

audience does not need to be told that, through a series of years, machine building is a close business, done under a small margin of profit at best, that any profits at all are possible only under good management, that any fund for a general increase of wages simply does not exist, and that, unless accompanied by an increase of product, such a general increase is impossible. Now, this system does what no union has ever attempted to do—it shows how it is possible for the employer to raise wages, and by an amount which no union has ever dared to ask. Not only that, it makes it to his own interest to do so, and it would seem as though, rightly understood, there is here substantial ground for amicable agreement. If this does not offer such ground where is the hope of peace?

As I have often pointed out, the interest of the workman lies in high wages per day, but the interest of the employer lies in low wages per unit of product. There is no necessary antagonism here. That rate of wages which will secure the lowest rate per piece is the rate which it is to the employer's interest to pay. Taking present prevailing wages as a starting point, the premium plan, by dividing the earnings due to increased production between the two parties, increases the workman's rate per day, but reduces the employer's rate per piece. The principle is as solid as the everlasting hills. If this does not offer a basis for harmony, then harmony is impossible.

It seems to me that if I were a union official of any influence, I would swing my hat and declare that this is what I had been looking for.

Program of the Cincinnati Meeting of the American Society of Mechanical Engineers.

The complete program for the forty-first meeting of the American Society of Mechanical Engineers is now ready. The meeting will be held at the Grand Hotel, Cincinnati, May 15 to 18, inclusive. On Tuesday evening there will be an address of welcome by the Mayor of Cincinnati and response by Mr. Chas. H. Morgan, president of the society, with an informal reception and smoker. On Wednesday morning will be held the business session, followed by the reading of professional papers, and on Wednesday afternoon an excursion will be made on the Ohio River, with a visit to the plant of the United States Cast Iron Pipe & Foundry Company, and in the evening more papers will be read. The reading and discussion of papers will be concluded Thursday morning, a ladies' excursion to the Rookwood Pottery and the Cincinnati Art Museum occurring at the same time. In the afternoon there will be an entertainment of the members by the Triumph Ice Machine Company, and in the evening the reception and conversazione at the Hotel Arms. A visit to the works of the National Cash Register Company, Dayton, Ohio, is arranged for Friday.

The following is the list of papers to be read at the meeting: "On the Value of a Horse-power," by Geo. I. Rockwood; "Hot Water Heating from a Central Station," by H. T. Yaryan; "Systems of Efficiency of Electric Transmission in Factories and Mills," by W. S. Aldrich; "Design of Speed Cones," by J. J. Guest; "Multiple Cylinder Engines," by Robt. H. Thurston; "The Gas Engine Hot-Tube as an Ignition Timing Device," by Wm. T. Magruder; "Water-Softening Plant of the Lorain Steel Company," by N. O. Goldsmith; "Education of Machinists, Foremen and Mechanical Engineers," by M. P. Higgins; "The Automobile Wagon for Heavy Duty," by Arthur Herschmann; "A Test of a Fifteen Million High Duty Pumping Engine at Grand Rapids, Mich.," by M. E. Cooley; "Tests of the Snow Pumping Engine at the Riverside Station of the Indianapolis Water Company," by W. F. M. Goss; "Cylinder Proportions for Compound and Triple Expansion Engines," by B. C. Ball.

Topical discussions: "What Does it Cost to Run Trains at High Speed?" "Protection of Pen-stocks from Corrosion."

The list of names of candidates to be voted upon at this meeting for membership in the different grades is unusually large, the total being 132.

Some interesting facts relative to the growth of the pneumatic-tool business were given by Mr. J. W. Duntley, president of the Chicago Pneumatic Tool Company, in some remarks at a recent meeting of the British Institution of Mechanical Engineers. In five years' time the output of his own company had grown from 100 machines per year to 800 per month, and this production will soon be still further increased. It is found that rivets to be driven in this way must be longer than when driven by hand, as they fill the holes much better—a fact which is further shown in cutting up old work. Hand-driven rivets drop out when the heads are cut off, but rivets driven by the pneumatic hammer must be driven out.

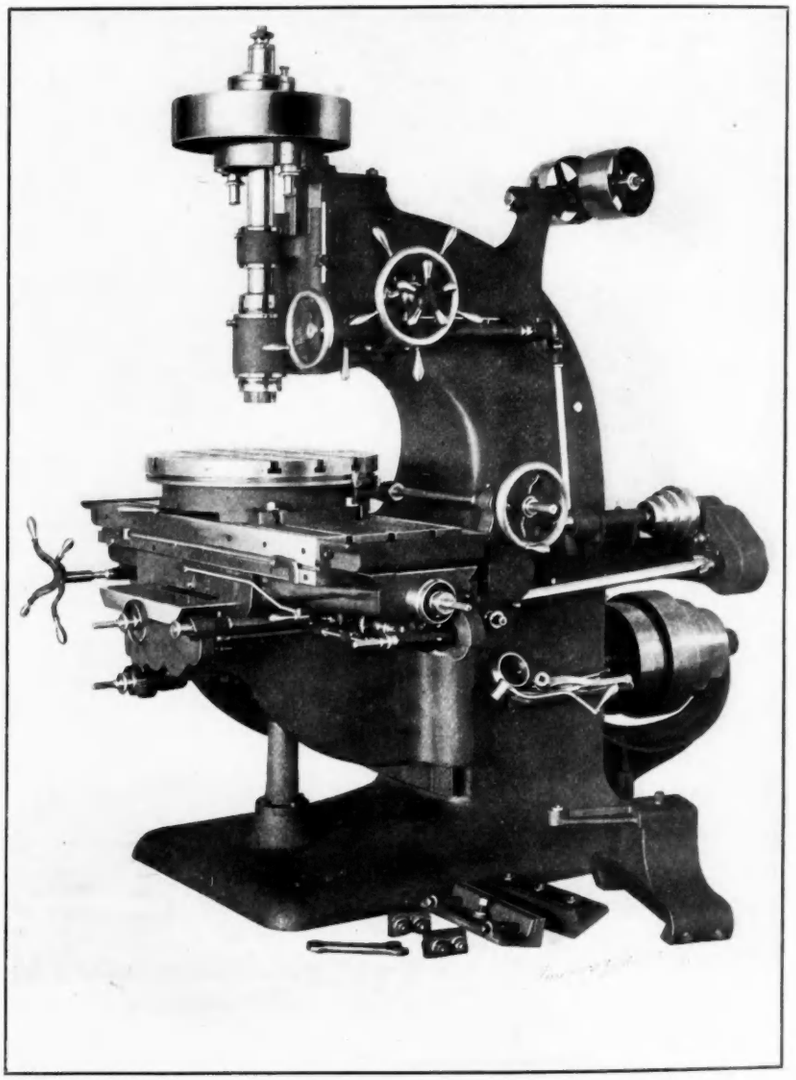


FIG. 1. IMPROVED VERTICAL SPINDLE MILLING MACHINE.

Improved Vertical Spindle Milling Machine.

The vertical spindle milling machine shown in the half-tone, Fig. 1, speaks for itself as to the variety of work of which it is capable and also of its strength and general efficiency. This machine is the latest development of the now well-known Becker vertical milling machine, and will not require a long and detailed description. It is to be known as the No. 5B machine. The shop drawing of the assembled machine, Fig. 2, which is reproduced almost exactly to a scale of 1 to 16, shows the construction very clearly. Long bronze bearings, adjustable for wear, are provided for the spindle, which at the main bearing is 3 inches in diameter. It is bored to B. & S. taper No. 11, the mills being secured rigidly by a drawbar. The end of the spindle is also threaded for large face-mills. The spindle driving pulley, on an adjustable auxiliary bearing is back-geared 5 to 1, the back gears balanced by duplication. There is a vertical movement, either hand or automatic, of 9 inches, and an automatic stop-dog to throw out the down feed at any moment when the spindle is used for boring. A micrometer stop-gage is used for minutely accurate depths of cut.

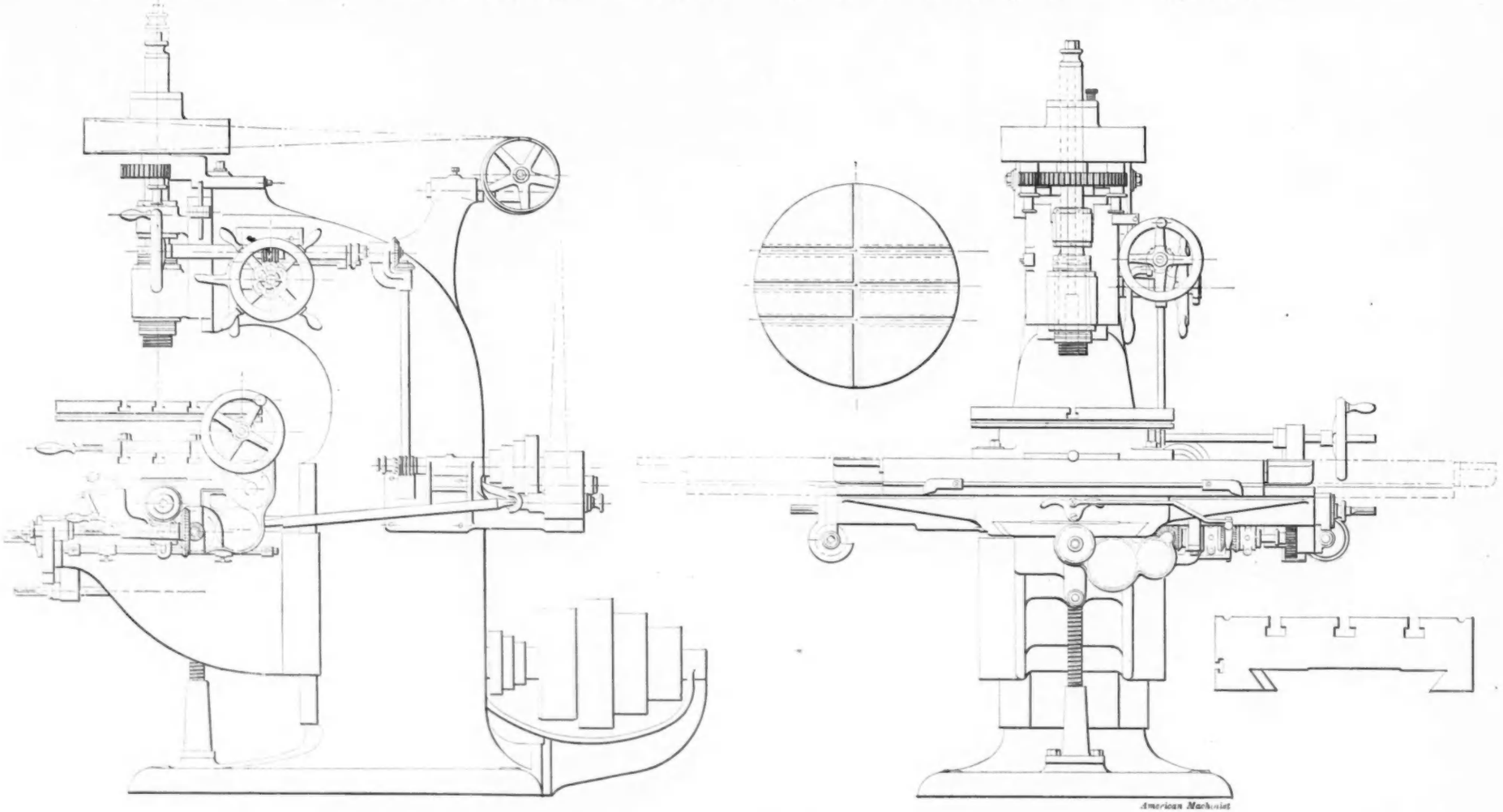


Fig. 2

FRONT AND SIDE ELEVATIONS OF VERTICAL SPINDLE MILLING MACHINE.

The platen of the machine is 51½ inches long over all and 14 inches wide, with 42 inches feed in either direction and a 3 to 1 quick return. The saddle is the same length as the platen, and this has an automatic cross-feed of 16 inches. Both the feed screws are dialed. Oil channels on the platen conduct the oil to removable oil pockets. There is an automatic vertical feed for the knee, and the revolving table is automatically fed in either direction. The extreme distance between platen and spindle is 21½ inches, and between rotary table and spindle it is 16 inches. There are eight changes of feed for the table and sixteen for the rotary attachment. An arbor support attachable to the knee is used for side milling with long and slim cutters. Vise jaws, 9x2½inches, working in the T-slots of the table are provided. The countershaft has double friction pulleys, 18 and 12 inches diameter respectively and 4½ face. The weight of the machine is about 4,500 pounds; hight, 81 inches; width, 65 inches; depth, 88½ inches. An automatic oil pump with connections is provided. Fig. 3 shows some cutters suitable for use in the machine. The machine is made by the Becker-Brainard Milling Machine Company, Hyde Park, Mass.

The S. J. Standard Metric Thread in Continental Europe.

BY HENRY HESS.

In the past many attempts have been made looking to the adoption in Continental European practice of a uniform system of screw threads. The nearest realization to this was the fairly widespread adoption of the English Whitworth system; this has, in fact, been so far adopted that Whitworth taps and dies are purchasable from the stock of nearly all the larger supply houses.

To work with both millimeters and inches in the same shop, and not infrequently on different portions of a single piece, is too illogical an arrangement to maintain itself. A further complication is brought about by the fact that, though like in name, an inch is a widely varying quantity in different sections; in Germany alone there are at least half a dozen, of which at least two, the Rhenish and the English, are in such very general use as to cause great confusion. It is this intolerable state of affairs that has given birth to a great number of proposals of different systems, many emanating from important machine building establishments and that have by them and their business connections been brought into partial use. Finally various engineering societies took up the matter and appointed delegates to draw up and sift proposals. The work occupied a number of years, and in the fall of 1898 culminated in the adoption by a congress of delegates from Germany, France, Switzerland, Italy and other countries using the metric system of measurements, of a shape of thread and pitch, to which they assigned the name "Systeme Internationale," generally known by its abbreviation, "S. I.," or "S. J.," as for some inscrutable reason the Continental European prefers to use the J in place of I.

The shape adopted is practically that of the United States or Sellers system, in which the cross-section of the thread is an equal-sided triangle of 60 degrees, with the top flatted off by one-eighth of the hight. In the Sellers system an important error was made in not providing for clearance between the top of a bolt thread and the base of a nut thread; the same fault is found in the Whitworth system. General machine shop practice in the United States rid itself of this trouble by providing a clearance, and so throwing the fit on the sides of the thread, where it properly belongs.

The late Mr. Charles A. Bauer, of Springfield, Ohio, formulated a systematic plan, published in the "American Machinist" of May 12, 1892, for correcting this shortening of the United States standard. The European congress benefited by American experience, and adopted a clearance of one-sixteenth of the thread hight in the shape of a circular fillet tangent to the thread sides. The use of a round fillet has the merit of the Whitworth system of avoiding sharp thread bottoms that provide a starting place for rupture. The use of a flat top for the thread gives all the benefit of easy production inherent in the Sellers system.

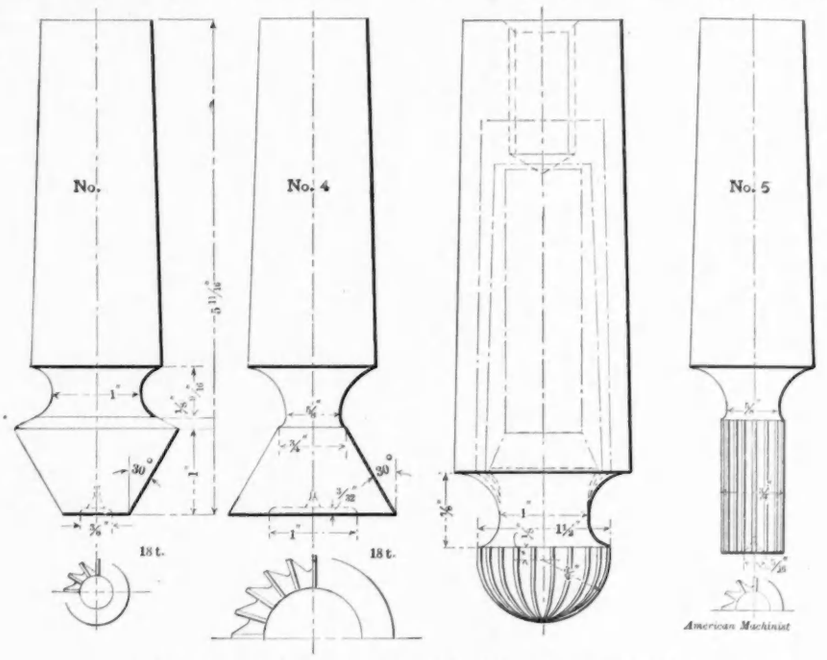


FIG. 3. SOME USEFUL STYLES OF MILLS FOR VERTICAL MILLER.

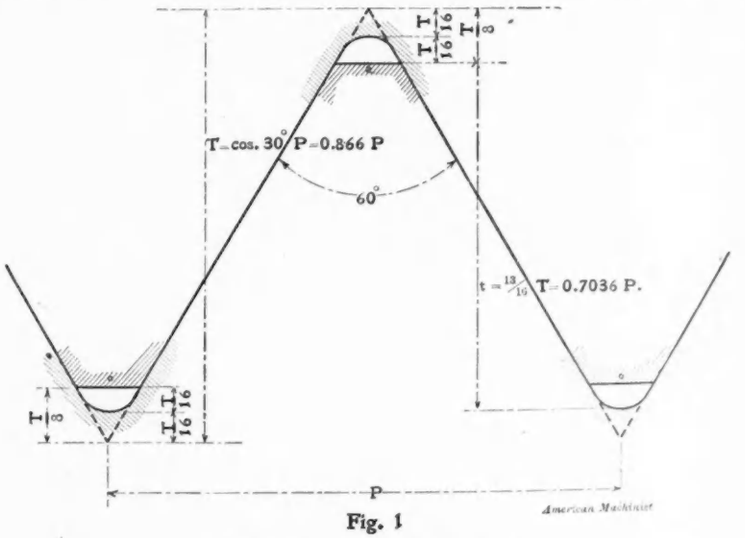


Fig. 1

STANDARD METRIC THREAD ENLARGED.

Fig. 1 shows the thread on a large scale. As the angle is 60 degrees, the hight of the triangle $T = P$ cosin. 30 degrees if P equals the thread pitch. Of this hight one-eighth is taken for flatting at

top and another one-eighth at the bottom, leaving the working thread hight equal ¾ T. As one-sixteenth of the hight is taken for clearance, the diameter of the bolt at the bottom of the threads is twice $\frac{13}{16}$ T smaller than the bolt body D; that is to say

$d = D - 2(\frac{13}{16} T)$, which reduces itself to $d = D - 1.4073\ P$.

With this arrangement the body of the bolt is equal to the nominal diameter, but the tap is made larger in diameter than the bolt by twice the clearance; that is to say, the tap diameter $D_1 = D + .1083\ P$.

The relation of pitches to bolt diameter adopted is graphically shown on the diagram. They will be seen to lie evenly distributed to either side of a fair curve. The actual pitches of the United States system are shown on the same diagram by dots; they are much less evenly disposed with relation to the fairing curve. This difference is probably due to the unit of measurement in the two systems; the millimeter in this case at least lends itself to a better arrangement without going into more awkward fractions for the measurement of the pitch than ½. The inch basis introduces such awkward fractions as $\frac{1}{18}$, $\frac{1}{19}$, $\frac{1}{11}$, $\frac{1}{7}$, and even such monstrosities as $\frac{1}{2\frac{7}{8}}$, $\frac{1}{2\frac{3}{8}}$, etc. This is an instance in which the often quoted argument for the English as against the metric system of continued conveniently expressed fractions works out in favor of its opponent.

Further comparison of the S. J and United States pitches is favorable to the bolts of the latter, as the pitches are finer. Long practical experience has certainly proven the United States pitches to be sufficiently coarse, so that a further increase has the bad effect of weakening the bolt core. The difference in area of cross-section of the bolt core (and consequently of resistance to tension) is very small for bolts, and increases to about 6.5 per cent. for a 6-inch bolt, in favor of the United States system. It is at least open to question whether the designers of the S. J. arrangement did not do well to stick to a conveniently arranged set of pitches, even at the cost of this small amount of weakening of the bolt.

The question of chief interest in all this for the American manufacturer who exports thread-cutting machines and small tools to Continental Europe is that relating to the advisability of his fitting up to meet the market. A few of the considerations on which he must base his decision are:

1. The very great need of a standard, owing to the great diversity of present practice.

2. The necessity that such standard be based on the meter, rather than the inch, due to there being so many different inches in use in the same countries as to necessitate them being further qualified as "English," "Rhenish," etc.

3. All of the important engineering societies have officially adopted the S. J. arrangement.

4. The S. J. arrangement has, with only minor modifications, stood the test of some years' use by a considerable body of French and Swiss engineers.

5. Under similar conditions in the United States the United States system quickly made its way to universal adoption, although the urgency was not as great, there being in use only a single unit of measurement—the inch.

6. One very important concern, that of Ludw. Loewe & Co., of Berlin, has expended great sums in fitting up for the manufacture of taps and dies to the S. J. standard, while others are similarly engaged.

7. On the other hand, the unquestionably much greater indifference of the European engineer as compared with the American to questions of uniformity of practice and to standardization must not be ignored; nor

8. The expense involved.

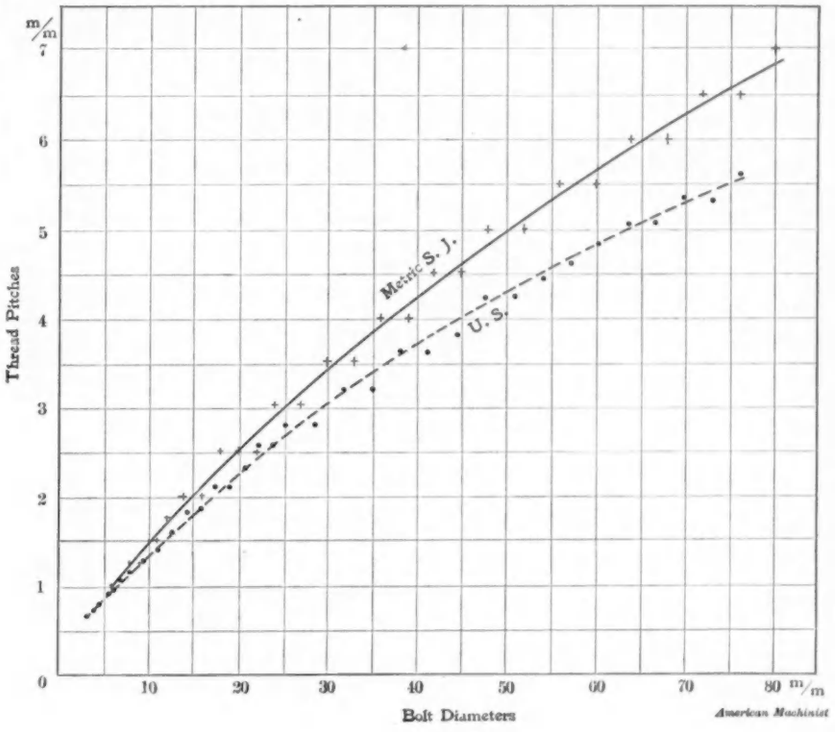


Fig. 2

RELATION OF PITCH TO DIAMETER—METRIC AND U. S. STANDARD THREADS.

Siamese Industries.

Consul-General Hamilton King writes to the State Department upon the industrial development of Siam. The following extract from his report indicates the prospects for various lines of American machinery in that country:

"Rice cultivation is the principal industry of Siam. There are twenty-six steam rice mills in Bangkok, and, although the first one in the country was started by an American, none are owned by Americans to-day. Four are European and the rest are owned or managed by Chinese. Some of the Chinese firms have a very large capital. Seven of the mills have their own electric light plants, one of which was furnished by an American house; all the other supplies and the rice-milling machinery used here have come from England and Scotland. A few years ago the paddy or rice husk, which is used for fuel, was so cheap that much waste was permitted in its consumption; now, however, the rapidly increasing price of fuel has created a good market for this husk, and efforts are being made to economize by introducing more improved methods of combustion. Teak wood is the next most important industry of the country, and there are ten large steam sawmills and many smaller hand mills in the city for the manufacture of teak lumber. Three of the mills have their own electric light plants, and all of them get their machinery and supplies from Great Britain. Twenty years ago shipbuilding was carried on quite extensively. At present, however, there are only four small docks and shipyards, and only small boats are constructed. There have been built on an average for several years past about twenty-five steam launches of from 17 to 30 tons burden; thirty cargo boats (craft about 50 feet in length by 13 feet beam), and eight lorchas, or Chinese sailing craft, 110 feet in length by 22 feet beam; while hundreds of the smaller boats of all descriptions that swarm the rivers and canals are turned out every season. All supplies and machinery for this industry come from Europe. There are four large machine shops and foundries in Bangkok; also the shops

of the two railroad systems, supplies for which likewise come from Europe. The large electric lighting plant for the city and the two power houses for the electric tram-car system obtained their equipment in Europe and the United States. There are in the city twelve printing establishments in which English type is used and twenty-four in which Siamese printing is done. These include in their output three daily papers, periodicals, and books of all descriptions, besides many lesser publications and much job work. The printing supplies for the city, for the most part, come from Europe. The United States is now furnishing a portion, however, and American paper has, within the last year, made a decided hit, and is just now increasing in favor."

The carriage building industry, the consul says, is rapidly growing in Bangkok. That city he believes to be a long way ahead of any other city in the Far East in the use of wheeled vehicles, and 90 per cent. of these are now manufactured locally. The greatest obstacle to American trade is the cost of freight, due to repeated trans-shipment *en route*. There is but one line from Bangkok direct to Europe, which goes to Copenhagen. The Germans are coming to the front in Siam very rapidly.

The Rear-Driving System for Automobiles—II.

BY M. C. KRARUP.

In the days when front-driven bicycles were more in fashion than now it was a matter of common observation that the rear wheel was likely to slew when the rider attempted to turn a corner at high speed; and from this fact an argument has been borrowed against front-driven and in favor of rear-driven automobiles. If a front-driven vehicle, it has been said, on which the rider resists the effect of the centrifugal force by leaning inwardly at a turn, slews out behind, how much more pronounced would this tendency be with an automobile, with which gravity cannot be employed as an offset to the force that causes the skidding? Now, it is true that empty wagons drawn by horses are frequently seen to skid behind when they are driven fast around a corner; but nevertheless the argument is not corroborated by observations made under truly parallel conditions. It has, perhaps, been overlooked that in all front-driven bicycles with which the slewing was noticed the steering post, or axle around which the rear portion of the vehicle turned in relation to the front wheel, was inclined forwardly—as is the steering post of modern bicycles as well—so that a turn meant a tendency of the rear wheel upwardly at the same time as outwardly; or, in other words, away from the ground so as to neutralize the ground friction upon which the stability of the wheel depended. The wheel would therefore slew whenever the centrifugal force was sufficient to cause the rear portion to turn on its pivot describing an arc at the point of ground contact.

But slewing was an incident to the general design of those bicycles, and not inherent in front driving. It is easy enough to design a front-driven bicycle with which side-slip will be less likely to occur than with the present style of rear-driven bicycle, the point depending mainly upon the angle of the steering post and its relation to the point of ground contact of the rear wheel.

In automobiles the above-mentioned causes for skidding evidently do not exist, and when slewing is noted with empty horse-drawn vehicles it should also be noted that the rear portion of such vehicles seldom swings out unless the driver uses his whip and makes the horses jump and jerk. Besides, the wagons, being empty, have small weight compared to the power of the horses; the tires are usually iron ones, which slip easily, and springs are either lacking or so stiff, being calculated for a load, as not to prevent the wagon from fitful bounding when empty and thereby increasing the chances for side-slip. With fine carriages slewing is rare.

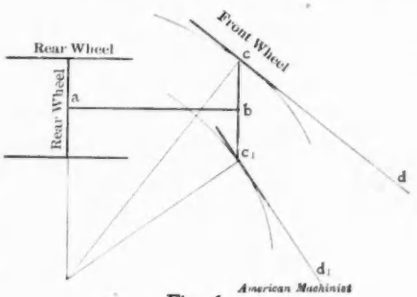


Fig. 1

In a general way it is noticed that with rear driving both the rear and the front portions of the vehicle must be made strong and heavy, because the front portion, with steering mechanism, is placed between the power and the resistance, while with front driving the rear portion need be little heavier than required for carrying the pay load of the vehicle. And, as usual, the argument in favor of front driving holds good for the tractor system as well, or better.

The general proposition as stated, that rear driving necessitates a vehicle which is built very strongly throughout, while other forms of driving permit lighter construction in some portion, is, I believe, unimpeachable, and should, in conjunction with the other reasons pointing in the same direction, have weight. But it has apparently never been considered as serious by our designers. Perhaps it is too general and vague to compel obedience until each designer shall have expended a few more thousands of dollars on acquiring experience with a design thrust upon us.

One of the companies that manufacture electric vehicles in Berlin and has supplied the German Imperial Postal Department with automobiles for the collection of mail matter and transportation to railway stations considers front driving of sufficient importance to make it a feature of all its vehicles. It accepts the necessity of making the driver turn the heavy battery, which is supported over the front axle, by main force whenever a steering motion is required, rather than trusting to vertical wheel pivots and the accompaniments of this feature, and with the object distinctly in view of avoiding the strains on the vehicle which are inseparable from rear driving. "On a smooth road," says the designer of these vehicles, in substance, "the work of turning the heavy front portion by hand power is light, even at slow speed, and for soft or rough roads, where the steering might task the muscles of the driver too heavily, electric vehicles are neither adapted nor intended."

The German authorities generally have so far steadfastly adhered to this conservative view that electric vehicles are unfit, by their economical and mechanical limitations, to travel over any but asphalted or hard macadamized roads.

The disadvantages of rear driving and a complicated steering mechanism, which the Berlin manufacturer has deemed it so desirable to avoid, may perhaps be summarized as follows:

(1) Waste of power at turns, resulting from applying the power in the direction *a b*, Fig. 1, to make the front wheels move in the direction *c d*. Especially serious at sharp turns on a steep up-grade (where sharp turns are naturally frequent on account of the same surface conditions that cause the steepness of the road).

(2) Stresses on vertical front wheel pivots, hubs, spokes, rims and tires, resulting from same cause, and avoidable by front or tractor driving.

(3) Necessity for using air tires to alleviate said stresses; coupled with which necessity there is an unsolved problem in regard to securing air tires to the wheel rims in such manner that the tires will not be disrupted or unfastened when quick turns are made, in emergencies, or when an obstruction or rut in the road tends to turn a front wheel.

(4) Upsetting of the vehicle, from the momentum of the rear portion, if any vital part of front structure gives way while the vehicle is moving at high speed.

(5) Backward somersault of vehicle on up-grades when the resistance to progress becomes greater than the resistance to hoisting of the front portion of the vehicle into the air. Several instances of this effect are of record, though perhaps only one in the United States.

(6) Constant jarring of steering mechanism, vibration of front wheels and mental and physical strain upon driver, because the driving power, acting from the rear, tends to turn still more a wheel accidentally turned by inequalities in the

road. By front driving, on the other hand, the forced rotation of the front wheels counteracts the swerving of the wheels from their course, or the action of the wheels is, at worst, neutral in regard to the direction. With tractor driving the front wheels of the vehicle, if any there are, are, of course, held to the direction of the tractor, as horses hold a wagon to their direction by the pole, and the tractor itself operates similarly to a front-driven automobile; but the freedom from traditional limitations that the designer of tractor wheels enjoys should enable him to produce a construction by which the chances for lateral impulses from the roadbed would be materially reduced, as for example by making the tires very broad.

In case a steering mechanism is used for the rear-driven automobile which is locked against reaction from road inequalities by use of worm gear or otherwise, it is, of course, true that vibration of the steering mechanism will only take place within the narrow limits determined by the necessary play and clearance in the mechanism—and this non-reciprocating style of steering mechanism is therefore distinctly preferable for rear-driven vehicles—but, as before mentioned, steering gears of this kind are not yet in general use in the United States and, especially when sensitive, must be made very substantial and heavy in order to resist the shocks to which they are exposed.

Many more observations might be made to illustrate the peculiar unfitness of the rear-driving system for automobilism on average roads and streets, and the writer had intended to analyze the comparison with other driving systems more in detail, but it seems now as if the foregoing, which is limited to almost incontestable points, should be quite sufficient to shake the touching confidence in the "of-course-ness" of rear driving which has so far been manifested.

The "Sentinel" Air Hoist.

We are enabled to lay before our readers drawings showing the construction and operation of the "Sentinel" air hoist, built at the "Sentinel Works" of Messrs. Alley & Maclellan, Glasgow, Scotland. This hoist is made with cylinders from 4 to 20 inches in diameter, lifts of 4 to 10 feet and lifting capacities from 500 to 20,000 pounds, using the ordinary air pressures of 5 to 6 atmospheres, or 60 to 75 pounds, gage.

The hoist is shown complete in Fig. 1. The cylinders of all sizes are of cast iron, and the pistons and stuffing boxes are leather packed. In the design of the hoist all contingencies likely to occur in the use of compressed air for hoisting seem to be provided for. An apparent novelty in this hoist is the spherical bearing for the suspending eye of the hoist. This enables the hoist to be swung off at any angle, and both the weight and the air pressure assist to keep the spherical joint tight. The air hose is connected near the top of the cylinder and the air passes through the vertical side pipe to the valve at the lower end. Should the hose burst or be broken, or should the air supply fail from any cause while a load is suspended, an upwardly closing check valve at the top of the pipe closes instantly, retaining the air pressure in the hoist and preventing the load from dropping. Fig. 2 will assist in showing the operating valve. This valve is provided with an index plate, the face of which is seen in Fig. 1, and which shows how the valve is to be moved, either to lift or to lower the load. It is worked by a long cross handle with, in the larger sizes, a chain for each end. The taper plug or valve is separate from the spindle, which has a cross channel fitting over a corresponding projection on the end of the plug, thus relieving the latter of all sidewise action from the pull on the handle. The valve works with perfect freedom and is always tight.

In the lower cylinder head are fitted two valves which form a combined air saving and balancing device. This guarantees the continued suspension of the load, and the use of only sufficient air pressure for the given load, so that when a light load is raised additional air will not be wasted by the subsequent filling of the cylinder with air at the full supply pressure, as is often done with some of the common types of hoist. The operating valve being opened and left open, the hight of the lift is determined by the position of the adjustable collar on the piston rod below and outside of the stuffing box. When the load has reached the desired hight, the adjustable collar comes in contact with the cross-shaped sliding sleeve which is held down by a helical spring, one arm of the cross operating a piston valve on the left and the other arm later operating a poppet valve on the right. When the piston valve rises it shuts off the air supply and the hoisting stops. If the load becomes lighter, as occurs, for instance, when pouring molten iron from a suspended ladle, the piston rises a little higher, and then the poppet valve is opened and a little air is discharged from the cylinder, leaving the pressure within just sufficient to bal-

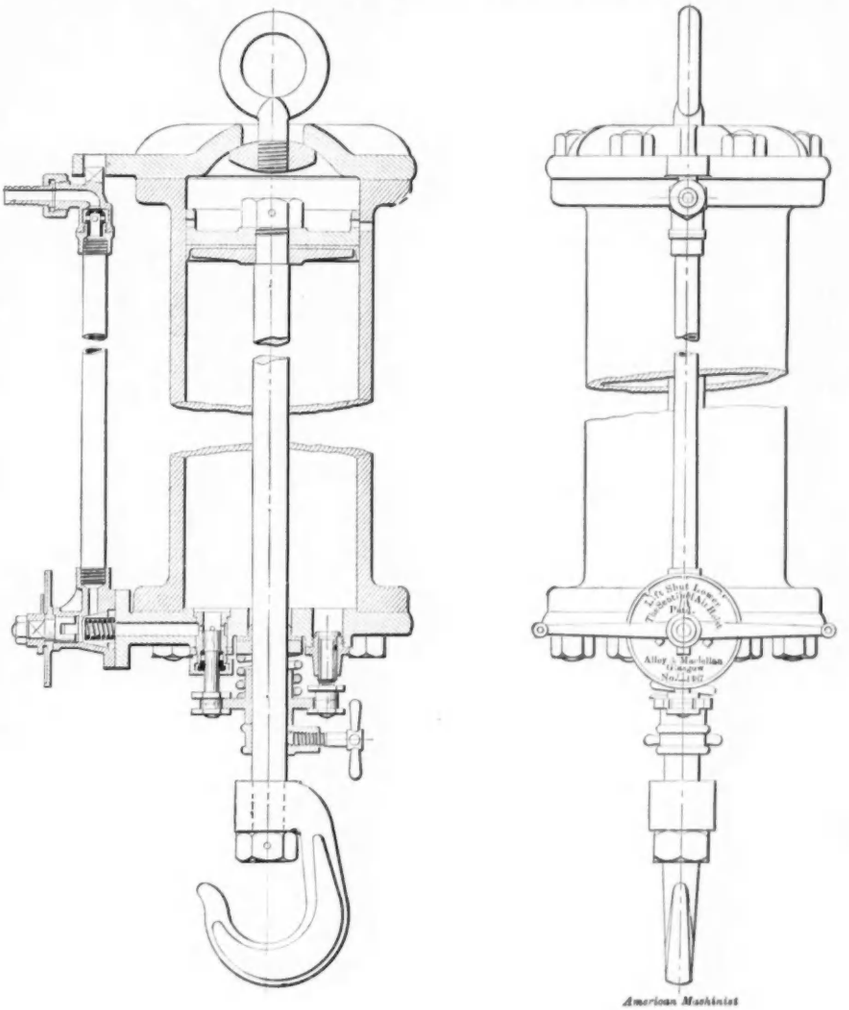


Fig. 1

THE "SENTINEL" AIR HOIST.

ance the reduced load. If a load is to be sustained for a considerable time and a little leakage of air occurs, the piston descends a little and the piston valve at the left admits a little more air, and so on. When the piston valve is up it, of course, closes the exhaust from the main outlet; on reversing the handle of the operating valve to lower the load, the release first takes place through the by-pass *a* until the piston descends a little, and after that the air escapes through the main outlet *b*. An air cushion is formed in the upper

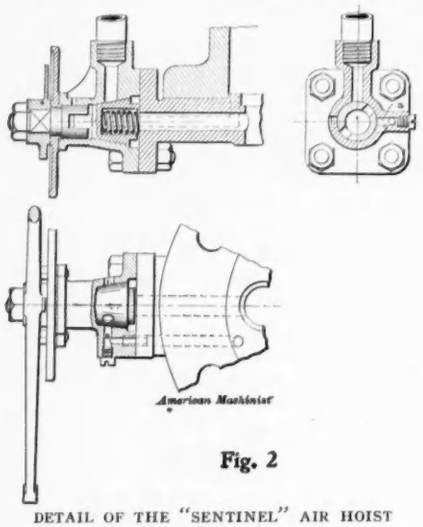


Fig. 2

DETAIL OF THE "SENTINEL" AIR HOIST OPERATING VALVES.

end of the cylinder by drilling a small hole near the top. The piston, when it gets near the upper end of its stroke, blocks this hole, and thus encloses the air contained above it, which, upon its compression, cushions the piston and brings it gently to rest. This, of course, occurs only when the automatic stop on the piston rod is not in use.

Letters from Practical Men

A Few Words to Young Draftsmen.

Editor American Machinist:

In making the drawing of an object from the model, as a beginner is likely to do, it is well to observe the following order: Look the model over carefully and determine the number of views necessary to illustrate it fully, drawing the same, free hand, in their proper relation to each other, on sketching paper. Look the sketch over carefully to see that nothing has been omitted, and put on dimension lines, after which scale the model carefully and put on dimensions. Do not put in the dimensions at the same time the dimension lines are drawn; have all the dimension lines in place before attempting to insert dimensions. This will keep the drawing much cleaner than by placing dimensions and dimension lines at the same time, for in scaling the model, especially if it be a machine or part of a machine that has been in use for some time, the hands will become more or less soiled, the dirt transferring itself to the drawing. If the dimension lines have been placed and the space reserved for the dimensions, the little finger may be used in steadying the hand for putting in the dimension, thereby reducing the possibility of soiling the sheet. Place title and date upon each sketch for future reference.

See that the sketch is now so complete that anyone who understands drawing could work from it without having to refer to the model. I have seen sketches made by draftsmen which were incomplete, some parts "carried in the head," as they would say. This course should not be followed, for it might be very exasperating for some other draftsman to have to search the head of the maker for the missing link.

Being satisfied that the sketch is complete, make the drawing to scale, leaving sufficient room between views for dimensions, notes, etc. Follow the same order in making the drawing with instruments as was used in making the sketch; that is, draw the views in their proper relation to each other, put in dimension lines, then dimensions, and lastly notes and title. If section drawing is made, do not draw section lines in pencil.

In inking the drawing, ink the lines of the object first, then center and dimension lines; put in dimensions and notes, then the section lines (if section drawing is made), and lastly the border lines and title. In inking lines of the object, ink circle arcs first, beginning with the largest, next irregular curves, and lastly straight lines, beginning with the horizontal lines at the top of the sheet and working down, then the vertical lines, beginning at the left and working to the right, and last, the oblique lines.

If shade lines are used, shade circle arcs and irregular curves as you go along, but with the straight lines follow the order already given for straight line work, first with the fine lines and then with the heavy lines.

If black is used for dimension and center lines, a finer line should be used to distinguish them from the lines of the object, but should colored ink be used, they may be made the same thickness as the lines of the object, for on the blueprint they may be easily distinguished from the lines of the object by their having a blue tint instead of the clear white line made by the black, which is due to the fact that the colored inks are less opaque than the black.

Arrow heads, figures and letters should be in black, and made with a common writing pen. A pen with a ball point is preferable, giving an equal thickness of line, no matter in which direction the stroke is made. A. B. BABBITT.

[The above seems to come along quite opportunely, soon after Mr. Tecumseh Swift's recent letter upon "Draftsmen Wanted." It of course is not intended for trained and experienced draftsmen, but for those who wish to become draftsmen of the self-made variety it may help to start them in the right direction.—Ed.]

The Workmen's Choice in Chucks.

Editor American Machinist:

In the "American Machinist," No. 13, E. S. Newton asks: "Why do workmen prefer the independent four-jaw lathe chuck to the universal three-jawed, or do they or do they not?" I have used chucks for thirteen years, and in that time I have used a good many kinds, the three and four-jawed mostly, independent, universal and combination. I have watched my shop-mates whenever they have had occasion to pick out a chuck for their own use, and I can say that they have always chosen a four-jaw independent or combination chuck. If a combination chuck was chosen, it was not on account of the universal feature, except in cases where the independent jaws would not open far enough. Then they would use the universal portion enough to help the independent jaws to catch the work. They then seemed to forget the universal portion, and use the independent jaws.

The reasons for the preference of the four-jawed independent chuck seem to be: First, that the work is held so much more securely. The friction of the hold is as 4 is to 3 for the same pressure on each jaw. Second, the four-jawed chuck will generally catch anything that the three-jawed will, and a vast quantity of work that it is almost impossible to hold in the three-jawed. Most of the work that comes to a lathe for a chuck to hold is either round or four-sided. It is nearly impossible to hold a four-sided piece in a three-jawed chuck; while a three-sided piece, which is a very rare thing, is easy to hold in a four-jawed chuck; Third, the work is not as likely to be sprung by a four-jawed chuck, as the pressure needed to hold it in place is applied at four instead of at three places, and as the arc of a circular piece between each jaw is less when using the four-jawed than the three-jawed chuck, the work is less liable to spring out between the jaws. Fourth, I have never found a three-jawed universal chuck that had been used any time that the work could be put in and run perfectly true. S. J. M.

Oil City, Pa.

Chuck Preferences.

Editor American Machinist:

In the "American Machinist," No. 13, Mr. E. S. Newton asks some questions about chucks. As to why the four-jawed chuck is preferred, I would say that it is because the four-jawed chuck is the best, and that *good* workmen usually prefer it for that reason. It is superior because of its wide range, its gripping power and its durability. It can handle square, trian-

gular, oblong, oval, irregular, eccentric and round pieces, and work chucked in it can be centered or trued to a nicety, for the reason that the jaws opposite each other act together as a pair to hold the work while the other pair are adjusting it, and this operation is alternated and repeated until the work is "true." The amount of use and abuse that a well-made four-jawed independent chuck will stand much exceeds that of a three-jawed universal chuck of the same size. The four-jawed chuck cannot be thrown "out of true," for the simple reason that the jaws are independent, and even if the jaws are "sprung," they can easily be taken out and a little ground off at the chuck end of the jaws' faces, which will bring them back square with the chuck again and ready to grip and true up the work as well as ever.

In the three-jawed universal chuck, however, comparatively little will spring it somewhere or other. If the jaws are "out," it is a long and tedious cut-and-try job to get them right again by the method just spoken of. In some few cases we might find an internal or external grinding fixture, as the case might be, for the lathe, and grind the jaws true in the chuck on the lathe spindle, or else anneal, turn the jaws true in the chuck, and then reharden. In this method there would be the error due to rehardening. Then, again, if the jaws have been "sprung," the scroll (in case of a scroll chuck) is most likely sprung also at those points bearing against the jaw teeth at the time of the springing. For instance, I have had a three-jawed universal chuck that was thrown out so badly while turning a piece of 1⅝-inch stock (round) that on a piece extending 4 inches from the chuck the error was 1-16 inch, while on 1½ or 1¾-inch stock the error was scarcely perceptible. I know of no way to correct such a fault other than getting a new scroll for the chuck, and that would probably necessitate new jaws also. This style of chuck is, however, very handy on work adapted to it, when rapidity is placed before accuracy.

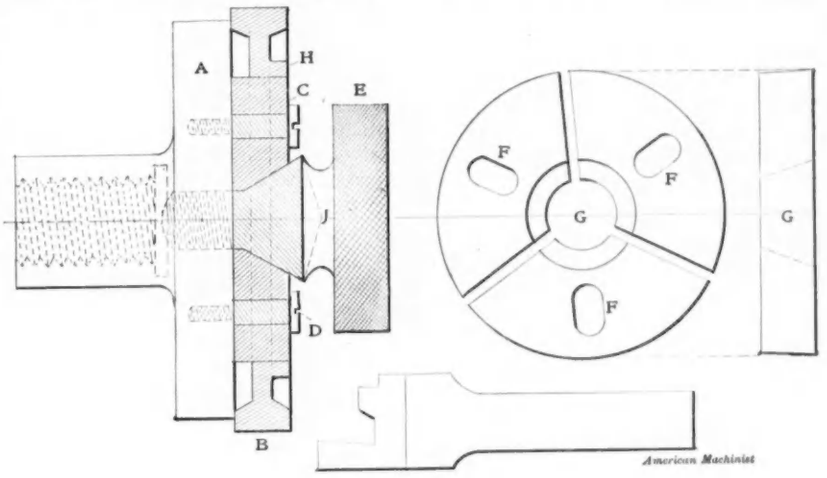
The geared screw universal chuck and the combination universal and independent chucks are not nearly as serviceable as the two already spoken of, being stiff in their action, feeble in their grip, inaccurate, and easy to get out of order. The combination chucks mostly find their way into the smaller shops, where the same machine is used for special work and then again for a number of duplicate (?) pieces, for which the universal attachment may be used. The universal four-jawed chuck is not a mechanical success by any means, for the work has either to be perfectly square or perfectly round, if the chuck is true, to be properly gripped by all four jaws. The pressure which is applied to three points of contact in the three-jawed chuck is now distributed over four points, and therefore the gripping power must be less, and in case of the work being a little irregular or the chuck's jaws being a little "out," one pair of jaws grip tighter than the other pair, facilitating a wobble of the work under action of the tool, causing it to be turned elliptical instead of round, this being most noticeable at the end farthest from the chuck.

MIKE ROMETER.

A Special Chucking Device.

Editor American Machinist:

The work to be turned was a brass ring, 6¼ inches in diameter by ¾ inch wide, and the hole 4¼ inches, with a valve seat at *H*. It had to be finished all over, and done as quickly and cheaply as possible, as we were using large numbers of them continually. The figure shows the fixture complete, with the ring in place. *A* is a casting bored and threaded to fit the lathe spindle, turned all over, and a tapped hole true with the center cut in to admit the knurled screw *E*, which is of machine steel turned on centers, with a 15-degree taper at *J*, and knurled heavily in order to get a good grip. *C* is the part which holds the ring *B* true and tightly while turning. It is a piece of machine steel turned and faced to 4¼ inches diameter by ¾ inch wide, and a taper hole *G* turned in it to fit screw *E*. After it was turned and fitted, it was put in place, screw *E* was tightened and the holes F were laid out and drilled to admit the screws *D*, which were to hold the piece in place. After the holes had been drilled and tapped in *A*, as shown, the piece *C* was removed and cut in three sections, as shown, then put in place and the screws *D* tightened so as to just allow the sections to move without any play. The work was then put in, the hole being bored and the side next to A having been faced in a previous operation; the screw *E* was tightened, which caused the three sections of *C* to grip the work tightly. Having been turned slightly taper on the outside, they pressed the ring firmly against the true face of *A*. The forming tool was then run up and the job was finished in one cut, the work being released by simply loosening the screw. The taper parts were case hardened.



A SPECIAL CHUCKING DEVICE.

JOS. V. WOODWORTH.

Brooklyn, N. Y.

A Chuck Suggestion.

Editor American Machinist:

A short while ago there was in the "American Machinist" some discussion of the good and the bad points of the scroll chuck. Let us for a minute take up some of the other chucks that the mechanic comes in contact with and expose one of their bad points. The manufacturers of chucks cut a series of grooves on the inner surfaces of the jaws, the first one about ⅛ inch from the back, as in Fig. 1. If a piece of work to be chucked has a sharp edge it will slip out into the first groove when the jaws are tightened, as shown, forcing the work away from the jaw at that point and against the jaw at the opposite point. Such work, with sharp edges, chucked in this way will not run true, and it cannot be driven back until released, and when released and set back against the jaw the same trouble will be repeated when the jaws are tightened again. If the manufacturers of chucks, in-

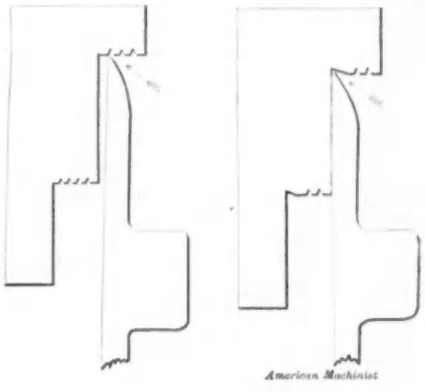


Fig. 1 Fig. 2

A CHUCK SUGGESTION.

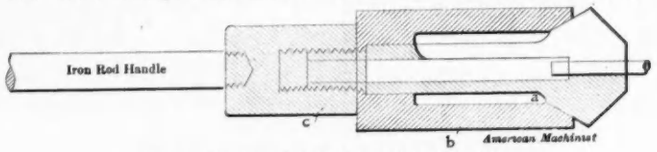
stead of cutting these grooves in the jaw, would cut one groove, tapering to the back of the jaw, as in Fig. 2, of any slight depth and width, the work would be forced against a true face and would run true, and the difficulty would be overcome. Some shops may never experience this trouble, but it happens very often in the repair shop. PAUL S. BAKER.

Muscatine, Iowa.

Truing Spring Chucks.

Editor American Machinist:

In the "American Machinist" of March 1 I saw an article by Mr. Walter Gribben, under the heading of "Trueing Spring Chucks," wherein he describes how he did the job. Providing Mr. Gribben had a bench lathe where the chucks fitted, he went to a good deal of unnecessary trouble, with very uncertain results. In the first place, the emery would be sure to work back to the collar *C* and lap it out so as to make the brass rod shake and produce a bell-mouth hole in the chuck. Secondly, suppose the chuck opened up in hardening, how would he close it on to the lap? If the chuck was of any size he must have an iron grip to do it with the fingers.



DEVICE FOR HARDENING SPRING CHUCKS.

Here is what I think is a better way of doing the job: I will begin with the hardening, as that is of great importance. After the chuck is finished ready for hardening and the hole left .001 or .002 inch small, according to size, slip it into a cast-iron sleeve *b*, which has the front end bored out to fit the angle of the chuck for a short distance; the other end fits the shank as far up as it is slotted. Then place a wire of the same size as the hole is bored in the chuck and draw up lightly on the nut *c*, so that the wire will not fall out when heating.

Take hold of the iron rod which is screwed into the nut c for a handle and heat the front end of the chuck and sleeve to a red heat as far as point *a;* then plunge the whole thing vertically into water, covering the whole business. Polish the shank up and draw blue up to point *a;* if this is done quickly the shank will be about a spring temper and the head will show just about enough color to take the strain off.

For lapping out the hole, make a couple of steel tapers to fit in the tailstock spindle; turn the end of one to about .001 inch smaller than finished size in chuck, and the other full size. Charge with diamond powder by rolling between two hard surfaces; a couple of fine files ground smooth on one side will do. If diamond powder is not at hand, copper laps and flour emery can be used.

The chuck is placed in the lathe spindle and the lap in the tailstock spindle, the small one first, then run the head spindle backwards and hold the left hand lightly on the hand wheel on the draw-in spindle, with friction enough to close the chuck easy on the lap; feed the lap out and in with the tailstock screw. Use lard oil on lap. After cleaning the hole out with the first lap, finish up to size with the other one. When the job is done, the hole will be true and straight and the chuck will need no touching up on the outside.

A. A. H.

Spiral Gears.

Editor American Machinist:

The spiral gear subject is indeed an interesting one, and the article by Robert Bruce, to which you call attention in your issue number 15, shows it is being looked into graphically. This method is probably accurate enough at times, but would it not be better, when possible, to use the simple rules, such as the Brown & Sharpe Manufacturing Company give in their "Treatise on Gears," and so get the angle of spiral exact in the figures, and then the milling machine may be geared as closely as possible to cut this angle, and thus get only the error due to this gearing and avoid the chances of errors in two places?

I have used these rules in actual practice and they are very easy to apply, and I think would not take as long as laying out graphically.

Example—An inquiry came in the other day, asking if we could cut a set of spirals for a small gas engine. A blueprint was sent, but lacked information as to angle and pitch of teeth. It called for one spiral of 14 teeth, the other 28 teeth, both the same diameter—4 13-64 inches. The drawing was full size, so I scaled the size of teeth and took it for granted they were 8 pitch.

I used the rule: If normal pitch and angle are known, divide normal pitch by cosine of angle and quotient will be the linear pitch. All I needed then was the cosine of some angle that was twice the cosine of its complement. I ran down the cosines in the table, and found that 63° 26′ and 26° 34′ gave me the correct angles, their cosines being .4472 and .8944. I then divided the normal pitch, which I had determined as 8 pitch, or .3927″, by these cosines. The results I multiplied by the number of teeth and divided by 3.1416, giving me the pitch diameter, and then added ¼ inch, the working depth of teeth, and found I came out 4 11-64 inches. This was not exactly the diameter called for in the drawing, but it was as near as they needed. I thought the example might be interesting, as it brings out the fact that when two spiral gears are geared together at right angles, with ratio of 2 to 1, and both the same diameter, then their angles are 63° 26′ and 26° 34′.

Perhaps this is well known, but I have never seen it published, and as these gears are frequently used on gas engines it might be useful to someone.

Rockford, Ill ERNEST J. LEES.

Effects of Remelting Iron and Scrap Steel in Changing the Carbon and Other Metalloids.

Editor American Machinist:

The very able articles of Mr. J. E. Johnson, Jr., seen in the "American Machinist," Nos. 14 and 15, exhibit broad experience and observation in the subjects treated. I am pleased to note that Mr. Johnson endorses the discoveries made by me in remelts of chilled iron being softer than those of the gray iron to come from the same casting or the same grade of iron, as such will assist in causing founders to abandon the old practice of thinking it necessary to set aside the chilled parts of car wheels, plow points, etc., from the gray portion of such castings, for fear of the chilled parts hardening mixtures intended for machinable work, etc.

In Mr. Johnson's second paper, page 344-32, where he refers to the changes due to remelting, he says: "Some carbon is always burned out in remelting pig iron." I also had supposed such to be true, until I made some experiments on this point, and then I found the contrary to be the case, as may be seen by a study of tables 1 and 2.

	Charcoal Pig Iron.	First Remelt.	Second Remelt.	Third Remelt.	Fourth Remelt.	Fifth Remelt.
Total Carbon.....	3.94	4.10	4.30	4.47	4.68	4.76
Graphitic Carbon...	3.06	2.90	2.42	2.90	2.67	3.16
Combined Carbon ..	.88	1.20	1.90	1.57	2.01	1.60
Silicon	.82	.75	.63	.66	.57	.59
Sulphur	.02	.03	.04	.04	.045	.048
Manganese	.78	.66	.53	.31	....	.25
Phosphorus	.232	.248	.274	.237	.254	.271
Specific Gravity	7.01	7.30	7.35	7.40	7.47	7.46

TABLE 1.

CHANGES OF ANALYSES IN REMELTING PIG IRON FIVE TIMES.

	Scrap Steel	First Remelt.	Second Remelt.	Third Remelt.
Total Carbon	.60	1.48	2.74	3.05
Graphitic Carbon ..	....	....	....	.15
Combined Carbon..	.60	1.48	2.74	2.90
Silicon	.31	.26	.14	.35
Sulphur	.02	.10	.14	.18
Manganese	.34	.23	.15	.06
Phosphorus.....	.166	.167	.190	.198

TABLE 2.

CHANGES IN ANALYSES IN REMELTING SCRAP STEEL THREE TIMES.

We find in Table 1 that, starting with the pig iron containing 3.94 total carbon, five remelts gradually raised it to 4.76, an increase in the total carbon of nearly 1 per cent. To check these results with a metal having a lower carbon than char-

coal pig iron, I took some scrap steel, having .60 carbon, and, as can be seen by a study of Table 2, three remelts of this steel raised it gradually to 3.05, an increase of total carbon in this case of nearly 2½ per cent.

The above tables are of value not only in showing the effects of remelting on the total carbon, but also on the silicon, sulphur, manganese and phosphorus. The tables show that the silicon and manganese are decreased, while the sulphur and phosphorus are increased, the latter very slightly, which facts are well established in the general practice of founders melting in cupolas.

A point rather peculiar in the above tests is that seen in the silicon being increased in the third remelt of both tables. It would look as if there were something more to be learned on this point.

On the whole, the silicon is not reduced as much in the heats above tabulated as is found in general practice, with regular heats. The same can be said of the increase in sulphur, which is rather small. These two latter factors may be due to my experiments having been made in a very small cupola, in which the metal came down very fast. This fast melting would not leave the iron subjected to heat to burn out the silicon or increase the sulphur as long as is generally the case in every-day founding. Looking at the matter from this standpoint, we would have to conclude that still more carbon would be added to iron by remelting in general practice than is exhibited in the above tables, the analyses of which heats were kindly tendered the writer by Dr. R. G. G. Moldenke.

I believe it to be generally thought that more or less carbon is burned out by remelting iron, but is there any evidence that such is the case? The above tables are the only ones that I know of, giving the results of actual experiments, to test the question of the effect which remelting has on the total carbon. If there are any others having actual tests or records on the subject of carbons to show the contrary to that displayed in the above tables, it will serve the interest of founding to have them made known, as other conditions than those of the tests here recorded might give other results; but from a study of the above tables it would seem that there is a strong tendency for iron and steel to absorb carbon when remelted in contact with coke in cupolas, as was the case in the above experiments.

THOMAS D. WEST.

Very Different Ways of Making a Simple Pattern.

Editor American Machinist:

Pattern making is a trade of a great many different ideas. Every pattern maker, or nearly every one, when making a pattern thinks his way is the best, and still there are hardly two that think the same. I had occasion to see a small, simple pattern made for a casting which, finished, was like Fig. 1, about 4½ inches long, 4 inches in diameter at the large end, with a 2¼-inch tapped hole—a standard pattern at the works where made. This is a simple pattern to make, and to look at it you would say, "Why, any apprentice could make that;" but, nevertheless, I saw this made by a journeyman in this way. Fig. 2 shows the pattern, which was made of a solid block, and core prints *A A*

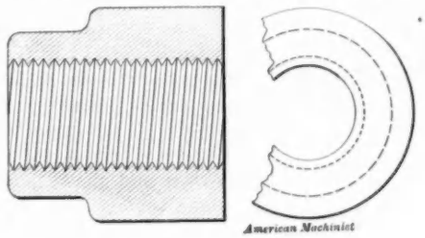


Fig. 1

A SIMPLE CASTING TO MAKE.

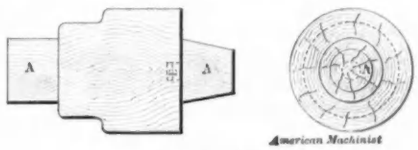


Fig. 2

ONE WAY TO MAKE A PATTERN.

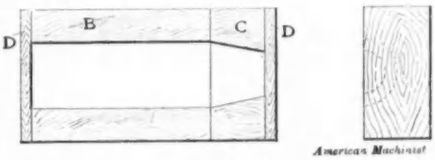


Fig. 3

THE CORE BOX.

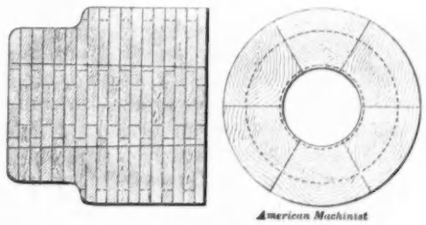


Fig. 4

A PATTERN WITHOUT CORE BOX.

turned separately, with a small dowel turned on the end *E* of the cope print. The core box was then made as shown by letters *B, C, D,* Fig. 3.

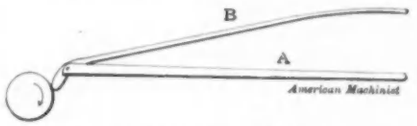
This is by no means what you could call a wrong way of doing the job, for I have seen a number of patterns made this same way which have proved very satisfactory. But I think there is a somewhat better construction, and one which will stay, if properly glued, a great while longer. The pattern in Fig. 4 is glued up in segments, and turned inside and out, and makes its own core. I describe this to show how even a simple job can be made in very different ways.

G. H. WILLARD.

A Feeler or Tell-tale for Truing Work.

Editor American Machinist:

In your issue of February 15 there is shown an apparatus for truing spring chucks, which I think is quite good for the purpose; but having had experience with the same kind of work, also with the truing of work of various descriptions in automatic screw machines, die work in the lathe, also work in the milling machine, but especially work in the universal grinding machine, work that was hardened and that was warped out of shape and which required resetting in the machine for refinishing, I devised the indicator in the sketch, and it has been used by myself in



A FEELER FOR TRUING WORK.

all the positions indicated, both for internal and outside indicating, or truing up. It has been borrowed by men everywhere that I have worked. It is always in use in preference to their more finely finished instruments for the same work, and is, like all useful tools, the simplest one you can make. It consists of the usual surface gage for the planer, the one with the 12-inch vertical rod preferred, as shown in the issue of February 22; but instead of the scratch rod there shown my affair consists of a straight piece of steel rod *A*, No. 55, forked at the end and the small wire feeler *B* jointed in. The rod *A* fits the surface gage, and the feeler is of small wire flatted at the end for the joint. As the short end of the feeler is but ¼ inch, while the other end is as long as you please, according to the line of work, it shows any variations very minutely. The feeler must work very freely in the fork, so that its weight alone will bring it down.

Bridgeport, Conn. JOHN L. COOK.

The Reading of Decimals.

Editor American Machinist:

I don't read decimals the way you do in your answer to question No. 10. I used to, but I have learned better. I don't call .48437 forty-eight thousand four hundred and thirty-seven hundred thousandths, but decimal four eight four three seven, or point 4 8 4 3 7. If I had a row of decimals to call off, such as .25, .125, .0625, .003125, I don't stop to think that the several denominators are hundredths, thousandths, ten-thousandths and millionths. I don't think, or form any mental conception whatever about the denominators, but I call them and think of them as point (or decimal) 2 5, point 1 2 5, point nought 6 2 5, point two noughts 3 1 2 5. Recently I have learned from the telephone girl not to say nought or ought, but Oh (that is the letter O, not the figure zero, or o).

Furthermore, I believe that nearly everybody that uses decimals frequently calls them off and thinks of them in the way I have described. If I were to ask you, Mr. Editor, to give, orally, the value of $\frac{1}{4}\pi$ to six places, you would say decimal 7 8 5 3 9 8. You would not say seven hundred and eighty-five thousand three hundred and ninety-eight millionths, and you would not think of millionths at all.

WM. KENT.

Tool Design at the Springfield Armory.

Editor American Machinist:

Referring to your article about the Springfield National Armory, published in your issue No. 12, I beg to state that although I give due credit to the inventive ability of my friend Mr. John Murphy, I must say that I am the man who was head draftsman in the Armory right after the time when the Krag-Jorgensen gun was to be manufactured—that is, October, 1892, till October, 1894—and that it was I who designed or had designed most of the tools, fixtures, jigs and contrivances for the manufacture of the new gun, both for the parts being manufactured in the Hill shops and for those being made in the Water shops. When I left the Armory on account of ill health, over 1,000 guns had been turned over.

J. A. LABRAM.

Levallois, France.

National Association of Manufacturers—Annual Report of the President.

The report of President Theodore C. Search presented at the fifth annual convention of the National Association of Manufacturers is a voluminous document. If reproduced in full it would cover more than ten of our pages. It is probably safe to say that if it was one-quarter of its present length ten times as many would read it. The paper, however, handles a great many important topics, and handles them well. The interval of fifteen months which has elapsed since the last convention is said to have been a period of industrial activity for which there is no parallel in American history. Manufacturers have had little to do in looking up customers, but have had to hustle to get material. Wages have advanced, so that labor may be said to be participating in a substantial way in the prosperity. Our foreign trade is developing so that we no longer measure our productive capacity by the absorption of the home markets, for the world is our market and all its people are our customers. The signs are that the present activity is to last for a long period, and all the nations are participating in it. A most gratifying feature of our foreign trade is that while our total exports have increased so rapidly the percentage of manufactures included in the total is also larger than ever, and still growing.

The paper takes up various topics in succession, beginning with the legislative work which has been initiated, and some of it accomplished, in the interest of the American manufacturer. The shipping bill is spoken of in detail. The policy is to seek to provide for the increase of the foreign trade of the United States, and to provide auxiliary cruisers, transports and seamen for government use when necessary by various measures which are enumerated.

Efforts are being kept up towards the securing of a federal act of incorporation for the association, with good prospects of success. No special favors and no appropriations are asked for, and the government is not to assume any responsibility. The sole purpose is to secure legal standing and prestige commensurate with the interests involved. The proposed new Department of Commerce and Industries as a part of the National Government is strongly advocated, as is also the Nicaragua Canal. Reciprocity treaties, the improvement of the consular service and proposed amendments to the interstate commerce law are successively discussed. Other topics of the report are: Legislative investigation, the parcels post, commercial possibilities of the Orient, the establishment of foreign sample warehouses, international transportation, an international freight bureau, a bureau of information and a publication department.

The paper concludes with words of congratulation for the success of the association and with enthusiastic predictions as to its future, concluding with the following paragraph:

"Unity is the element which determines the success of this association—unity of purpose and unity of action. Individual profit, personal gain or selfish motives never can put this organization forward a single step. We are working for the benefit of the manufacturers of the United States as a unit, not as makers of pig iron, spinners of cotton or builders of engines; but as a great body of producing industries whose interests are common, whose needs are the same and who must recognize that the continued prosperity of the individual depends upon the well being of the whole."

A London Commercial Exhibition of American Manufactures.

It is proposed to establish in London a permanent exhibition of American manufactures. There are hundreds of concerns abroad, who, if they could be made to realize the advantages of handling American products, would be only too ready to open up business relations with manufacturers in this country; but the difficulties of manufacturers in bringing their wares before the notice of the foreign consumer, and the like difficulty of the foreign consumer in discovering in America the goods he needs, has up to now been one of the barriers which has hindered many American houses from placing their goods in the foreign market. The remedy for this condition of things has been found by many of the larger manufacturers in this country by opening their own houses in the principal foreign cities, and by having their own representatives abroad, and by this means they have gradually brought themselves before the notice of foreign buyers, and have built up a foreign connection which in many cases has had the effect of doubling and trebling their business.

There are, however, at least two drawbacks to this step, which have deterred many from taking it: First, the expense of what many regard as being to some extent only a speculation, and, secondly, the responsibility of opening up a foreign branch three thousand miles away, with all its attendant worries and extra work.

The London Exhibition of American manufactures would have as its object the bringing of foreign consumers into actual contact with American producers, while relieving the latter of all responsibility and reducing the expense to a merely nominal amount. The principal advantages offered to American exhibitors will be as follows: (1) A public exhibit of the goods they manufacture in a central position in London. The space allotted will practically amount to a branch office and depot in London, which they can advertise as their London address, and to which they can refer any foreign inquirers who wish to see samples of their goods. (2) The exhibition management will undertake to personally represent exhibitors, taking entire charge of their interests, keeping exhibit in good order, answering all inquiries, distributing their price lists and printed matter, transmitting orders, despatching circulars, and, in short, rendering all or any service that would be given if the exhibitor had his own representative on the spot. A staff of experienced employees will be especially retained for this purpose. (3) A monthly bulletin will be published by the exhibition management, calling special attention to the exhibitors and their exhibits, which will be widely circulated among the principal importing houses and buyers of Europe, and special inducements will be offered to buyers to visit the depot and view the different classes of goods exhibited.

It is proposed to place the whole of the above advantages at the disposal of participants, including space in the exhibition, care of goods exhibited and storage of goods for sale, as well as any or all other services required, for a fixed nominal sum per annum, which will vary acording to the dimensions of space and the extent of the service which would be entailed.

Further particulars will be furnished by Pitt & Scott, Limited, 39 Broadway, New York.

Solid Hydrogen.

The solidification of hydrogen, which has recently been accomplished by Prof. Dewar, is an achievement quite fitting the closing year of the century, not merely for the importance and magnitude of the achievement in itself, but in the fact that it marks the end of a series. There are for the scientific experimentalist no more worlds to conquer in this direction. The last known substance has now been solidified, and we know that all matter may exist in either of three states, solid, liquid or gaseous. Liquid and solid hydrogen seem to possess more striking peculiarities than any other of the substances known to men. We feel that we are doing a service to our readers in reproducing, nearly in full, "The Engineer's" (London) account of Prof. Dewar's exhibition before the Royal Institution on April 6:

"Liquid air, liquid oxygen, liquid nitrogen and liquid hydrogen were on the lecture table in as great profusion almost as though they were only water, but one could guess the amount of labor and patience which had been expended in their production. When we consider the first lectures given by Professor Dewar in the beginning of his investigation into low temperatures, and when we remember the small quantities of liquid then produced, we can appreciate the vast strides which have been made in this interesting investigation. The ease, moreover, with which the most difficult experiments were carried out, is ample evidence of how thoroughly Professor Dewar and his assistants have mastered the behavior of the subjects of their investigations. We may be permitted, we think, to write 'their' investigations, for at the close of the discourse Professor Dewar spoke in hearty terms of the help afforded to him by his assistants.

. . . . . .

"Liquid hydrogen possesses properties not held in common with the other gases which have been successfully liquefied. This was, in a measure, to have been expected, seeing the properties possessed by the gas itself under ordinary atmospheric conditions. Taking, for example, a bowl of liquid air; when this is observed it will be noticed that the fumes coming off from it flow over the sides and descend down them. It is quite the contrary with liquid hydrogen, for in this case it is found that the fumes ascend just as do those from boiling water. This was what might have been expected, seeing how much lighter hydrogen as a gas is than either oxygen or nitrogen. As a fact, liquid hydrogen is no less than fourteen times lighter than water, and it is almost impossible to conceive such a fluid, when one considers that that most mobile liquid ether is three-quarters as heavy as water.

"A curious circumstance takes place when liquid hydrogen is allowed to boil away in an open dish. Almost as soon as it is poured out we see white clouds forming around the top of the dish. These are the fumes of air about to liquefy. This experiment was shown on Friday last, and when the hydrogen had all boiled away there was found in the dish quite an appreciable quantity of liquid air, formed in consequence of the intense cold of the evaporating hydrogen, which was poured out by Professor Dewar on to a cloth. It did not remain there long, for it disappeared almost as soon as it had made its appearance. Indeed, the difficulties of keeping the gases in their liquid state are evidently very great. Of course, they are kept in vacuum flasks, and in the case of the hydrogen flasks some of these are swathed in a covering, and the flask itself is kept in a vessel surrounded by liquid air and carefully covered up.

"An interesting experiment showed the difference between liquid oxygen and liquid nitrogen. An equal quantity of each was put separately into two glass vessels, and the air exhausted from each. The nitrogen gradually became viscid, and finally solid, while the oxygen remained liquid. It is impossible to solidify oxygen by this means, owing to the difference in the vapor tension of the two gases. If, however, a modification of Wollaston cryophorous be employed, and liquid hydrogen be used to cool one end of it, then liquid oxygen contained in the other end would solidify. This experiment was actually performed.

"A glass vessel consisting of a long tube, a part of which had been blown out to form a larger receptacle, was then produced. It contained hydrogen which had been sealed into the tube under pressure. The end of this tube was dipped into boiling hydrogen, and the hydrogen inside the tube began to liquefy and collect in the end of the tube. On being removed from the boiling hydrogen the liquid inside the tube was observed to very soon revert to the gaseous state. This, it was explained, was a most important experiment, having regard to the determination of the density of hydrogen and other questions. The next experiment was the actual solidification of hydrogen, which was carried out with the utmost success. Using one of the ordinary vacuum tubes to contain the liquid hydrogen, this was immersed in a further vessel containing liquid air. When the pressure inside the tube containing the liquid hydrogen was very gradually reduced, the liquid was first of all seen to boil gently, then much more quickly, and suddenly part of it became solid, the remainder following very quickly. As far as could be seen at a distance from the lecture table it was a thick, sticky, whitish substance which was produced. Professor Dewar talked of it as being a white frothy flocculent solid, and said that, though it looked opaque as seen by reflected light, in reality it was transparent. The melting point of this solid is just —258 degrees Cent., or 15 degrees of absolute temperature. The boiling point of liquid hydrogen is —250 degrees Cent., a difference of only 8 degrees. Its solidification had been, said the Professor, a matter of considerable disappointment. It was to have been expected that it would have been useful as an agent for obtaining still lower temperatures than had up to now been reached. Had it remained a liquid to a lower temperature this might have been accomplished, but in its solid form it did not lend itself easily to such a purpose.

"The uses of liquid hydrogen were manifold. With it, for example, solid oxygen can be prepared from the liquid by simply pouring the hydrogen on to the oxygen. This experiment was performed, and on being struck with a rod the solid oxygen gave out a ringing sound. The solid oxygen was poured out of the tube and its fall on to the table could be heard. Intense cold affected the luminosity of coal gas. An experiment showed the difference in luminosity of this gas when burnt: (1) As it came from the mains; (2) after having passed over solid carbonic acid; (3) after having passed over liquid air, and (4) after having passed over liquid hydrogen. In the latter instance the luminosity was practically *nil*. Liquid hydrogen was also useful in the separation of the more volatile gases of a mixture. The behavior of metals as regarded their conductivity of electricity at low temperatures was an interesting study. It had been supposed from investigations carried out with liquid air that at absolute zero of temperature there would be no resistance at all to electricity. By means of subsequent experiments at the lower temperatures now possible it had been discovered that the curve of resistance took a sudden bend in such a direction as to indicate a definite temperature for absolute zero. The difference of conductivity, however, of copper between the temperatures of liquid air and liquid hydrogen was most strikingly shown. In the first instance a coil of copper wire, in series with an electric incandescent lamp, had a current of electricity passed through it. At ordinary temperatures the lamp showed no indication that any current was passing through it. When the coil of copper was immersed in liquid air the filament of the lamp just showed red, and when liquid hydrogen was substituted for liquid air the lamp suddenly lit up brilliantly. The resistance of copper was, in fact, fifty-seven times less at the temperature of boiling hydrogen than it was at the temperature of melting ice. Another experiment showed how that by means of the application of liquid hydrogen to the outside of a discharge tube the discharge became more brilliant.

"At the conclusion of the discourse proper, Professor Dewar gave—at the instigation of the audience—that which is very rare indeed at the Royal Institution, namely, a speech. In this he referred to munificent donors, among them the Goldsmiths' Company, which had rendered it

possible to conduct the researches, which of necessity were costly. It would have been equally impossible to carry the experiments out without the whole-hearted co-operation of his assistants, Mr. Lennox, Mr. Heath and Mr. Petavel. There were some people, he remarked, who held that the researches were not worth the money they were costing. In reply to this he could only say that this was not his opinion."

Legal Notes—Defective Crane—Extraordinary Risk.

BY W. MARSTON SEABURY.

The action brought by John F. Nicond against J. G. Wagner in the Superior Court of Milwaukee County, Wisconsin, has recently been determined upon appeal by the Supreme Court of Wisconsin.

The plaintiff, Nicond, while working for the defendant in a structural iron works, was struck and severely injured by the end of a heavy iron beam suspended several feet from the floor of the factory by a chain attached to a traveling crane, operated by fellow servants to raise the beam to a sufficient hight to enable them to move it to an overhead track running at right angles to that on which the crane was located, there to be moved by an air hoist to and through a riveting machine. The plaintiff claimed that the crane was out of repair and was unsuitable for the work for which it was intended, and that the defendant was aware of this, and that the plaintiff was not aware of it until after the accident. The defendant offered as a defense the act of a fellow servant, which he contended was the cause of the accident.

The jury found that the crane had been operated with ordinary care, but that it was defective, and that its defectiveness was the direct cause of the injury. A verdict of $3,500 was rendered in favor of the plaintiff, and from the judgment in his favor the defendant appealed. The Appellate Court held that as there was *some* evidence before the jury to support its finding the judgment could not be reversed. (81 N. W. R., 999.)

EXTRAORDINARY RISK.

A man named Neidlinger was employed by one Yoost, who owned and operated a malt house, to stir and strain malt. He was at work in the cellar, where there were two sets of apparatus known as "conveyors." This conveyor was a wooden box about 18 inches square, extending the length of the room, 6 feet 6½ inches from the floor, having suspended within it a shaft wound with a spiral groove, which, by its revolutions, transferred the grain from one end of the room to the other. On the top of the box at intervals of from 8 to 12 feet were holes for oiling the shaft of the conveyor where it revolved through hangers from the top of the box. The conveyor, with its boxing, ran through a partition wall into the adjoining or machinery room. The box projected a little way into this room and the shaft continued on for about 8 feet from the wall until it engaged by a gear wheel with the gear wheels on the main shaft.

While plaintiff was engaged in his usual occupation the superintendent directed him "to oil the conveyor." The plaintiff got an oil can and poured oil into all the oil holes on top of the conveyor box, and then proceeded to the machinery room, and was about to oil at the end of the conveyor shaft where it engaged with the main shaft, when, in some way, his clothing was caught by the moving machinery and he was seriously injured.

The plaintiff brought suit to recover damages for his injuries upon the theory that he was instructed to perform a service outside of the line of his duty, which exposed him to danger from machinery to which his ordinary associations would not expose him, and that he was directed to do this without proper warning and instructions.

A verdict and judgment of $5,000 was rendered in favor of the plaintiff in the United States Circuit Court for the Southern District of New York, and the defendant appealed, but the Appellate Court declined to set aside the verdict of the jury, and affirmed the judgment of the trial court. (99 F. R., 240.)

Electrically Driven Tools in Europe.

Electrical driving of machine tools is being introduced in a growing number of European establishments, particularly in railway shops. In France the electric transmission system is already employed on a large scale by the Companies du Nord, de l'Est and du Midi. In Germany the shops of Dresden and, since a recent date, Carlsruhe receive power from a central station used also for lighting the buildings. In the last named establishment, to save expense, the proprietors were contented with replacing the existing steam engines by electro-motors, except in the wheel shop, which was reconstructed, and where each lathe is driven by its individual motor. The variations of speed are obtained either mechanically or electrically. In using 1,200 electrical horsepower the annual saving of expense of coal, lubrication and cost of maintenance is estimated at $6,000.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(12) F. R., Cincinnati, asks: (1) By what rule is the proper diameter of an eccentric for a 6-inch lift found? A.—An eccentric may be said to be always too large in diameter, and it is made so, not on account of the work that it has to do, but for the purpose of getting it on a shaft and for properly fastening it. (2) Do eccentrics work better with a strap than with a roller when the downward movement is affected by gravity? A.—Eccentrics work well with straps. We do not know what roller arrangement is referred to; there is none in common use. (3) Would two 3-inch cranks on the same shaft to work alternately require more power than two eccentrics of 6-inch lift? A.—If the eccentrics and the cranks have the same throw or lift, the cranks are to be preferred. They would both require the same theoretical power for the same work, but there would be more friction with the eccentrics than with the cranks. (4) Does a larger eccentric, say 15 inches diameter, require more power than a 10-inch eccentric for a 6-inch lift at 40 revolutions per minute? A.—The smaller eccentric is to be preferred. There would be more friction with the larger eccentric, especially the friction resulting from the springing of the strap.

Personal.

Eugene R. Pommer, M. E., has been appointed first-class draftsman in the Boston Navy Yard.

George B. Grant, of the Grant Gear Works, Boston, Mass., who has been at Pasadena, Cal., for some time, has returned to Lexington, Mass.

Sidney H. Wheelhouse, formerly sales agent for the Chicago Pneumatic Tool Company, has been made second vice-president of the Standard Railway Equipment Company, in charge of the pneumatic tool sales department for the West, with offices at 412-414 Lincoln Trust Building, St. Louis.

T. P. Kimman, assistant mechanical superintendent of the Standard Pneumatic Tool Company, Chicago, has just sailed for Paris in order to install and operate their "Little Giant" pneumatic tools and appliances at the Paris Exposition, where they will have a complete air plant in operation in the Champ de Mars and Park Vincennes.

Obituary.

A. S. Halldie, president of the California Wire Works, died in San Francisco, April 26, seventy-three years old. He designed and built the first cable road in San Francisco, which was also the first in the United States.

Two Ways of Inventing.

"He asked one of his sons, 'How would you go to work to invent a machine for accomplishing certain results?' The answer was, 'I would look up what had been done by others, in encyclopedias and other authorities, obtaining as thorough a knowledge as possible of the art.' 'If I should begin in that way,' Mr. Harvey said, 'I would never make an invention. I would never get out of the beaten track. No, I would solve the problem in my own

way first, and then find out what others have done in the same field; and it has usually turned out that I have solved the problem by an entirely original and usually simpler method.' "—"Memoir of Hayward Augustus Harvey."

Railway Motor Engineering is the title of a course of study by mail newly offered by The International Correspondence Schools, Scranton, Pa. The course was prepared and is being kept up to date by Eugene C. Parham, superintendent of the Nassau division of the Brooklyn Rapid Transit. It is intended for operators of electrical machinery and those who wish to become such, and contains practical instruction on the operation and maintenance of electric cars and motors.

New Catalogs.

The Narragansett Machine Company, Providence, R. I., sends a catalog of lockers, which are intended, among other purposes, for use in offices, shops and engine stations. It is 9½x6¾ inches.

The C. W. Hunt Company sends us a catalog of industrial railways for manufacturing establishments, which constitute one of its chief lines. At the end are illustrations of many special cars and a list of well-known users of these railways. The same company sends a catalog of steam and electric hoisting engines, with some mention of coal-handling machinery, chain, rope, etc. Each pamphlet is 6½x9¼ inches in size.

The Ball Bearing Company, Watson street, Boston, Mass., sends its priced catalog of ball and roller bearings. These are of many different forms and types. Among the apparatus are "hub" thrust collar ball bearings for drill spindles, the same for worm screws to sustain loads of 50 tons each, roller bearing hangers and boxes, carriage and motor vehicle axles, etc. The list of customers given is a very creditable one. Size of pamphlet, 5x7 inches.

We have received from the Cushman Chuck Company, Hartford, Conn., its catalog of improved lathe and drill chucks "of all kinds and for all purposes." It shows independent four-jawed chucks, improved reversible faceplate jaws, universal geared scroll chucks, two-jaw chucks, lever scroll chucks, drill chucks of various sorts, combination lathe chuck, bench centering chuck, special chucks for cutting-off machines, etc. Size, 4¾x7¼ inches.

We have received from L. Best, 45 Vesey street, New York City, a catalog of emery grinding machinery, polishing machinery and supplies. Mr. Best is agent for the Sterling Emery Wheel Company for this part of the country and handles a great variety of apparatus, among which we notice a cutter grinding machine, twist drill grinder, emery surfacing machine, swing frame grinding and polishing machine, diamond tools, etc. It is of standard size, 6x9 inches.

A catalog of the Fitchburg Steam Engine Company, Fitchburg, Mass., has been received from E. H. Ludeman, New York office manager, 39 Cortlandt street. The engines made by this company are adapted to purposes running up to large units, have certain notable improvements in valve motion, etc., and are made in cross and tandem compound as well as simple types. The company makes high-speed as well as slow-speed engines. Size of pamphlet, 6¼x10 inches.

The Vezin Machine Company, 97 Liberty street, New York, sends a little pamphlet descriptive of its small high-speed engine. The sizes given in the table range from 3.5—5.3 to 19.7—29.6 horse-power at 80 pounds of steam. The following data are given for one illustrated: Speed, 1,500 revolutions per minute; horse-power, 5.3; hight over all, 23 inches; weight, 150 pounds. Its peculiar merit claimed is said to be due to the method of automatic lubrication. The catalog is 5¾x3¼ inches.

The American Stoker Company, Washington Life Building, N. Y., sends a catalog of its mechanical stokers. These are constructed on the under-feed principle. The pamphlet contains a copious illustrated description of these stokers, with their advantages, results of tests, application to various boilers and in various plants, with some fac-simile testimonials. The illustrations show them in use with puddling, busheling, spring and axle as well as boiler furnaces. Size of page, standard, 6x9 inches.

Patterson, Gottfried & Hunter, 146-150 Center street, New York, dealers in machinery, metals, hardware, tools and supplies, have issued a catalog of certain makes of machinery for which they are agents. It includes the Springfield Machine Tool Company's lathes, shapers, presses, centering machines, etc., the Whitney Manufacturing Company's universal hand milling machines, drill chucks and collets, polishing arbors and water tool grinders, and the Builders Iron Foundry's grinding and polishing machinery, patent countershafts and belt shifters. Size, standard, 6x9 inches.

The Fellows Gear Shaper Company, Springfield, Vt., has just brought out a catalog of the machine indicated in its title. This book has evidently been prepared on the theory that what the readers of a descriptive catalog are after is not a moonlight view of the device presented, with some poetic eulogiums upon it, but that they want the nearest possible equivalent to examining and taking apart

(*Continued on page* 50.)

Miscellaneous War

Advertisements will be inserted ... head at 25 cents a line, each inser... should be sent to reach us not late... urday morning for the ensuing w... Answers addressed to our care ... warded.

Gear Wheels, gear cutting. Grant; ...

Caliper cat. free. E. G. Smith, Columb...

Forming lathes. Mer.Mach.T.Co.,Meriden, Ct.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

D'ftsmans booklet. D.J.Kelsey,NewHaven,Ct.

Shaft'g straighteners. J.H.Wells,Tampa,Fla.

Eye benders, angle benders, hand bending tools. Estep & Dolan, Sandwich, Ill.

Wanted—Will buy or rent small machine or bicycle repair shop. Box 326, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

Wanted—To purchase, complete drawings for six sizes of dough mixers. Address Baker, AMERICAN MACHINIST.

Selden Packing for Stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

U. S. patent (small tool) for sale or on royalty; selling well in Europe. Herbert, Cornbrook Park Works, Manchester, England.

Wanted—Address of William Salmond, machinist, from Canada. Address Mrs. Eliza Salmond, 76 Grange ave., Toronto, Ont., Canada.

Wanted—Second-hand lathes, gas engines, drill presses, motors; state condition, price and name of maker. H. Bertrand, Box 27, Glen Ridge, N. J.

Would be pleased to correspond with parties having some specialty in the line of light machinery to build or model work. Address Box 475, Hornellsville, N. Y.

For Sale—A double annealing and case-hardening furnace of Brown & Sharpe's latest pattern, in just as good order as when new; prices and terms very reasonable. Address Eclipse Bicycle Co., Elmira, N. Y.

"Loetzer's Hand-Book of Practical Rules and Tables for Machinists and Engineers"; revised and enlarged fifth edition just out; cloth binding, 65 cents; full leather binding, $1; agents wanted. C. E. Loetzer, Sayre, Pa.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Mechanical engineer and designer of 20 years' experience, desires position. Address E. F., AMERICAN MACHINIST.

Wanted—A position by an all-around automatic screw machine man. Address Thomas C. Kirby, 319 Jay st., Brooklyn, N. Y.

Pattern maker desires change; anywhere; California or South America preferred; best references. Box 340, AMER. MACHINIST.

Draftsman, 11 years' experience engine, gas engine and general work; technical graduate; good mathematician. "M.," AMER. MACH.

Experienced draftsman, 5 years shop, 6 drawing room; special and automatic machinery preferred. Box 334. AMER. MACHINIST.

Steam engineer and millwright of experience and ability, wants position, mill or factory; economic methods. C. A., AM. MACH.

A competent mechanical draftsman wishes position; mills located in Pennsylvania or Ohio preferred. Box 342, AMER. MACHINIST.

Shipwright, 26 years' experience, wishes position as designer; 12 years of yards, 14 years of office experience. Box 348, A. MACH.

Position as director of shop work or manual training department; have had 10 years' experience in a State university. Address "B.," care AMERICAN MACHINIST.

Wanted—Position as foreman, tool room; had experience on jigs, fixtures, subpress dies and small machinery; good references. Box 343, AMERICAN MACHINIST.

A mechanical superintendent with a good practical experience is open for an engagement; 8 years in last position; habits correct; references excellent. Box 341, AM. M.

Practical mechanic, with technical education and extensive experience in special machinery and tools for manufacturing purposes, wants position in charge of a Western shop. Box 344, AMERICAN MACHINIST.

Mechanical engineer and draftsman, technical graduate, wishes to change from present position; 18 years' experience as foreman, superintendent and master mechanic in shops producing small and medium duplicate machinery. Address Box 321, AM. MACHINIST.

A mechanical engineer, 43, broad experience, desires to make permanent arrangements to represent some house or houses on West Coast; has been a salesman, also contractor for machinery; can give good bond and references. Address F. H. Whiting, Tacoma, Wash.

Position wanted by first-class mechanical engineer and draftsman (40), to take charge of drawing office; experienced on marine engines, high-speed and Corliss engines, pumping engines, ice machines, blowing engines, installations of light and power plants, structural work, etc.; 12 years of shop and 14 years of office experience. For further particulars address Box 330, AMER. MACHINIST.

Help Wanted.

Superintendent, big factory making fine machine, like typewriter. Box 350, AM. MACH.

Wanted—Good mechanical draftsman for pump work; must be No. 1. Box 287, AM. M.

Wanted—Mechanical draftsman in machine shop in New York; please state age, experience and salary expected. Box 339, AM. M.

Capable draftsman wanted; one with experience on sugar machinery preferred; New York City. Address, with full particulars, Box 345, AMERICAN MACHINIST.

(*Continued on page* 50.)

(*Continued from page* 49.)

the real article. Text, half-tone illustrations and numerous line drawings unite in carrying out this theory. Another thing which must impress one who sees the superb pictorial setting in which the gear shaper is here placed, is that its makers have a good deal of respect for it. Size, standard, 6x9 inches.

Manufacturers.

An electric light plant will be installed in the Iowa State Institution, at Mount Pleasant, this summer.

A machine shop, 40x80 feet, is to be erected at Minneapolis, Minn., on Second street and Sixth avenue, South, for Henry L. Martin.

J. W. Roberts, of Tampa, Fla., will establish a plant there for making cornices and like work. Machinery has been purchased.

R. Heinisch's Sons Company, manufacturer of cutlery, Newark, N. J., is to build a small extension to its factory at 224 Thirteenth avenue.

The J. I. Case Threshing Machine Company, of Racine, Wis., is said to be going to build a $50,000 boiler factory, which will employ 200 men.

Emil J. Stehli and C. W. Barlow have been looking for a site at Lebanon, Pa., for a silk mill in connection with the business of a firm in Zurich, Switzerland.

An addition is to be erected at Krams avenue and Silverwood street, Philadelphia, Pa., by William H. Eddleman for James Stafford's Sons, manufacturers of blankets and yarns.

Revised estimates are being taken by William Steele & Son, Philadelphia, Pa., for an office and light manufacturing building for the Girard estate, at Third and Chestnut streets.

Ground has been broken at Ligonier, Pa., for a factory for making all kinds of turned wood. The promoters are George F. Huff, Greensburg, president; J. N. Boucher, Greensburg, secretary. John Anderson, of Ligonier, will be the manager.

The Sun Electric Company, capitalized at $1,000,000, is negotiating for the purchase of six acres of land on Haddon avenue, Camden, N. J., on which to erect a plant where 400 to 600 men will be employed in the manufacture of electrical appliances.

The Northern Engineering Works, crane manufacturers, Detroit, Mich., have found it necessary, on account of their increased electric crane business, to remodel a portion of the building formerly used as a foundry, and turn it into an erecting shop, giving them 50x 150 feet additional erecting space.

William Steele & Son, Philadelphia, Pa., are about to build for the Philadelphia Tapestry Mills Company a five-story granite and brick factory building, 60 by 305 feet, and a boiler and engine house, 36 by 42 and 49 by 42 feet, and foundations for a metal-encased stack, 100 feet high, at the northeast corner of Mascher street and Allegheny avenue. The total cost of the work is $130,000.

The Pittsburgh Reduction Company has removed its Eastern sales office from the Havemeyer Building, New York City, to the sixth floor of the Phelps-Dodge Building, Cliff and John streets, New York City, where it will be in charge of Mr. S. K. Colby. The company will carry in New York a small stock of standard sizes and grades of aluminum ingots, sheets and wire.

Hurd & Co. is the name of a new firm of engineers and machinists which has acquired the shop formerly operated by the Century Machine Company, 570 to 576 West Broadway, New York City, for the purpose of model and tool making and experimental work. The head of the firm is Mr. B. Hurd, a graduate

(*Continued on page* 51.)

Help Wanted—Continued.

Machinists wanted; experienced on bench and lathe work; steady job. Apply in person at Arlington Hotel or factory of Standard Pneumatic Tool Co., Aurora, Ill.

Molders—Wanted, four first-class loam and green sand molders; reliable men only; non-union preferred; highest wages. Address, with full particulars, Box C, Saltville, Va.

Wanted—Two good all-round machinists accustomed to new work and repairs; a steady job for competent, reliable men. Western Cane Seating Co., Michigan City, Ind.

Wanted—Man to take charge of planers, medium heavy and light work; state age and nationality; must be a first-class workman. Address Box 338, AMERICAN MACHINIST.

Wanted—Working foreman for blacksmith shop employing from four to six men and doing work for jobbing machine shop. Apply Clearfield Machine Shops, Ltd., Clearfield, Pa.

Experienced chemist and metallurgist wanted for large foundry and machine works in South Germany. Address, with references and state experience, "Chemist," Box 336, AMERICAN MACHINIST.

Mechanical draftsman wanted; must have experience on light automatic machinery; only first-class man need apply. Address letters, stating age, experience and salary wanted, Box 347, AMERICAN MACHINIST.

Wanted—A first-class designer, familiar with light, high-grade machinery of intricate design, also with tool manufacture; desirable position for right man. Address, with references, Box 331, AMERICAN MACHINIST.

Wanted—Foreman for new brass shop and foundry; must be experienced in steam fitters' goods and capable of taking entire charge of shop; give full particulars regarding experience. Address Box 349, AMER. MACHINIST.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Man able to take charge of a department in machine works making mill machinery; must be a thorough machinist and toolmaker and know how to handle unskilled help; state age, experience and references. Box 337, AMERICAN MACHINIST.

Wanted—Four first-class draftsmen on high-grade gas-engine, steam-engine and boiler work; state age, experience and salary desired; must be able to furnish references; none but sober, steady men need apply. Address "Industrial," care AMER. MACHINIST.

Wanted—A number of first-class iron molders; men who want to enter the employment of a company who believe in fair play and free labor; none but strictly temperate men need apply; steady work and good wages. Brown & Sharpe Mfg. Co., Providence, R. I.

We can use on heavy boring machines, planers and large lathes several first-class machinists who can and will make these machines do all they were designed to do; unless you can earn 30 or more cents per hour do not apply. Gates Iron Works, 650 Elston ave., Chicago.

Wanted—First-class, experienced draftsmen on high-grade interchangeable machinery, also tool-makers or A No. 1 machinists for our drafting room, capable of designing first-class tools and fixtures. United Shoe Machinery Company, McKay Department Factory, Winchester, Mass.

Wanted—A1 die and tool maker; must be thoroughly competent, otherwise pass this by, as we have no time to waste with incompetent so-called machinists; thoroughly equipped up-to-date shop; state wages, references, etc. Address for 10 days, American Addograph Co., Inc., 525 Philadelphia Bourse.

A situation is open for a working foreman of small foundry in town of about 10,000 inhabitants, in Central New York; to a capable and reliable man good wages will be paid; one of middle age and married preferred. Address, stating age, experience and wages expected, Box 346, AMERICAN MACHINIST.

Wanted—First-class layer-out for boiler shop, capable of laying out plates for all kinds of boilers, tanks and general jobbing products; must be sober, reliable and capable of working from blueprints, without other instruction. Address, stating age, salary wanted and present employer, "Layer-out," care AMERICAN MACHINIST.

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A man experienced and ingenious in making tools and dies for the accurate and economical production of small brass parts—in arranging piece work, handling help and getting out strictly first class product quickly and cheaply.

To a competent man, a large electrical firm about to double its manufacturing plant, offers attractive inducements. Address with full particulars and reference

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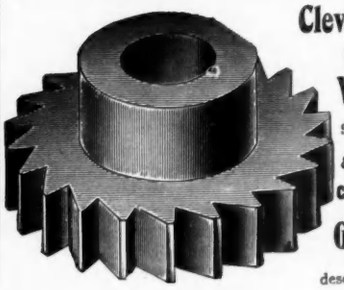

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